April 5, 1944

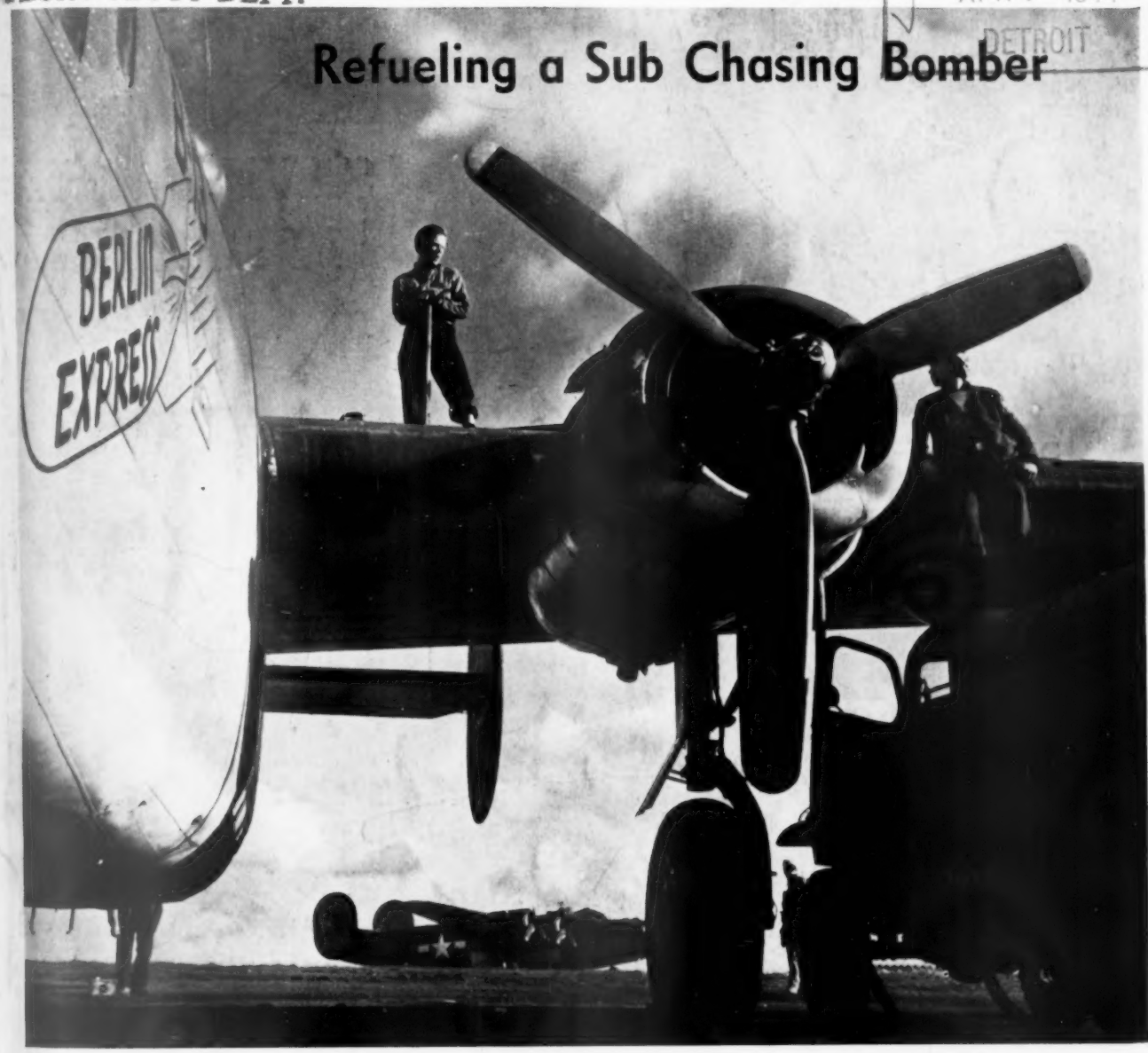
NATIONAL PETROLEUM NEWS

TECHNOLOGY DEPT.

APR 7 1944

DETROIT

Refueling a Sub Chasing Bomber



With the recent announcement that hundreds of miles of the Bay of Biscay have become "unsafe for shipping"—thus tightening the blockade on Nazi Germany—the role of U. S. Navy bombers patrolling this vast bay takes on new significance. For many months Navy airmen, based in Southwest England, have been performing the unending grind of scanning the waters of the bay for enemy subs, surface warships or blockade runners. Here the "Berlin Express", a U. S. Navy Consolidated Liberator assigned to the bay patrol takes on a load of 100-octane gasoline before starting on a mission. This is an official U. S. Navy photo

Where to Find These Important Developments:

Anglo-American Oil Conference: London announces personnel of British delegation to come to Washington in two weeks to negotiate international agreement. **Page 3.**

Honor the "A" Coupon Holder: Here's a tribute to the eight or ten million Americans who are sharing their gasoline with the holders of coupons calling for greater amounts. **See Page 5.**

OPA Drops Tire Inspection: After April 20th filling station men will no longer be burdened with this task. Administrator Bowles warns, however, that tire inspection records must be preserved. **Page 10.**

What's the Status of PDO 1? PAW Marketing Director Hochuli meets with Dist. 1 marketing committee to discuss this controversial distribution plan. **See Page 6.**

R V36² Ap-Je 1944

DONT LOSE IT

OIL IS AMMUNITION

SAVE EVERY PRECIOUS DROP

Morrison Line and Loading Valves

They Load Right

Provide Smooth Dependable Control Under All Loading Conditions

They Hold Tight

MORRISON BROS. COMPANY

OIL EQUIPMENT HEADQUARTERS

DUBUQUE, IOWA

Lengthening Shadow . . .

. . . that forecasts a **coming** event

Nearly completed is the new Republic catalytic "cracker" that casts its 20 story shadow over a Texas city.

It is one of the many new developments used to carry on our work in this war. But it foretells a huge story . . . of post-war operations . . . of powerful fuels . . . of Republic's plans for the future.

Because of the tremendous strides we have made—both in advanced scientific research for finer fuels . . . and in expansion of our production facilities . . . the blueprint for building post-war business has been drawn.

The coming event means more profit and increased sales for our dealers and marketers . . . for

REPUBLIC'S GOING PLACES

Just Issued

A new booklet explaining aviation gasoline in non-technical terms. Write for a Copy Today!

REPUBLIC OIL COMPANY

Benedum Trees Building, Pittsburgh, Pa.

George P. MacDonald . . .

Wins Praise as Dist. 1 S. & D. Manager

GEORGE P. MACDONALD, who recently was elected vice-president and traffic manager of the Sinclair Refining Co., chief marketing subsidiary of the Sinclair Oil Corp., has spent his entire business career in the oil industry with the exception of two years in World War I when he served as seaman and ensign in the Navy.

For the last year Mr. MacDonald has been manager of supplies and distribution for the Petroleum Industry Committee under Directive 59 in PAW Dist. 1. In this work he had the job of directing supplies and distribution for the whole industry in the 17 Atlantic Coast states comprising Dist. 1. His staff numbered several hundred persons, a fact indicating the scope of this task. And the outstanding work which he accomplished is recorded in the resolution of praise which the Supplies and Distribution Committee adopted in accepting his resignation.

Formerly Mr. MacDonald was vice-president and general sales manager for Richfield Oil Corp., New York City, with which concern he had been associated since its formation in 1929.

Mr. MacDonald has a wide industry acquaintance and has served on many industry and government agencies. He was vice-chairman of the northeastern Regional Code Committee under the Code of Fair Practices sponsored by the American Petroleum Institute and approved by the Federal Trade Commission. He was also chairman of the New York State Petroleum Code Committee under NRA.

Mr. MacDonald is a native of Philadelphia and attended the University of Pennsylvania. He now resides in Great Neck, Long Island, is married and has one son, James Alan, a cadet at Staunton Military Academy.

NEW WARTIME EDITION

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BULLETINS

MATERIALS POST FILLED

WASHINGTON — PAW, April 4, announced the appointment of William C. Brooks as special assistant to the director of the materials division, replacing Alvin Zwerneman who is returning to his post as vice-president of Axelson Manufacturing Co. Mr. Brooks, for the past four years assistant to the president of the Petroleum Equipment Co. of Los Angeles, will be in charge of the allotment of controlled materials to more than 400 petroleum equipment manufacturers who report to PAW as their claimant agency and industry division.

* * *

FORRESTAL BACKS PRC PIPELINE

NEW YORK—In speech to the Bond Club here, April 3, Undersecretary of the Navy James Forrestal said the Navy's interest in the Trans-Arabian pipeline project "lies solely in its realization that it is impotent without adequate supplies of oil."

"American concessions in Saudi Arabia," he said, "are a national asset of potentially tremendous value and even more than that, in American hands and developed by Americans they may be a great asset to the maintenance of peace. The method of the development of those reserves is of secondary importance, but the Navy is sure that the reserves themselves should be retained by Americans and be assured to our use if ever again we have to face the ordeal of war."

Further pointing up Navy concern over domestic reserves, Mr. Forrestal asserted that estimates by geologists of amount of untapped U. S. oil sources "are highly hypothetical" and "vary too widely to furnish a foundation for public policy."

* * *

TEXAS DRILLING INCREASES

AUSTIN, Tex.—Weekly report of the Texas Railroad Commission reflected an increase in Texas drilling operations for the week ending April 1.

There were 124 applications for regular drilling, raising the 1944 total to 1448 compared with 933 at the same time in 1943. Completions totaled 59 oilers and six gassers. Four wildcat wells were drilled and 16 proved dry holes.

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NATIONAL PETROLEUM NEWS

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Volume 36, Number 14

Big Step for World Oil Parley Up to Hull

Conferences to Open in Next Two Weeks, With Shell and Anglo-Iranian Spokesmen at Bat for England; U. S. Picks Delegation Soon

WASHINGTON — Anglo-American oil conferences opening here in about two weeks will mark the first, though most important, step in an effort by the United States government to negotiate an international treaty for the efficient and orderly development of the world's oil resources.

That fact became known this week following announcement April 3 of the personnel of the British group that will participate in the discussions and disclosure that the high American oil policy committee, appointed by President Roosevelt, with State Secretary Hull as chairman, will hold its first meeting within the next few days for the purpose of selecting the American participants.

Importance attached by the British to the impending talks is pointed up by the fact that the British delegation will include Sir William Fraser, chairman of Anglo-Iranian Oil Co., and Sir Frederick Godber, managing director of Royal Dutch Shell. Both are members of the British Petroleum Board.

The chairman of the group is Sir William Brown, a career civil servant and secretary of the Ministry of Home Security, who until recently held a similar post with the petroleum division of the Ministry of Fuel and Power.

Others in British Group

Commodore A. W. Clarke, of the Royal Navy and member of the British Joint Staff Mission to Washington, representing the military; Frederick Harmer, assistant secretary of the Treasury now on temporary assignment in Washington as United Kingdom Treasury representative here; J. H. LeRougetel, of the Foreign Office, and F. C. Starling, principal assistant secretary of the petroleum division of the Ministry of Fuel and Power, are the other members.

While the make-up of the group bears out a State Department announcement that discussions, in the first instance, will be "on an expert technical level," NPN was informed that the object of the impending talks will be to reach agreement on basic principles needed for a subsequent effort to negotiate an international oil convention, or compact, among all the oil-producing nations.

One high-placed government oil official, in particular, told NPN pointedly that it was "hoped that this is but the beginning of things to come—the first step toward a multi-lateral agreement on oil that will involve such other nations as Russia and Venezuela."

It was emphasized that while this is only the first move, it is also by far the most important. The reason, this official said, is that Britain and the U. S. are the two nations most vitally interested in the Middle East. In other words, unless they can agree on basic principles that will govern in that area there can be no hope of eventually reaching an agreement that will embrace all other producing countries.

World Interests Involved

Thus, while the talks will concern the world-wide interests of both nations, they will be directed primarily to a settlement of the problems arising out of the proposed entrance of this government, through PRC, into the petroleum picture in the Middle East. Possibility of a sharp increase in Arabian production, as a result of U. S. activity, obviously has created grave concern in British oil circles and has given rise also to a need for action on such pressing matters as production rates and practices, pipeline outlets, etc.

The prospect that the British and the Americans will be commencing their discussions within a fortnight followed the first show of activity by the Senate's National Oil Policy committee.

Sir William Fraser . . . member of British Oil Delegation

Meeting in executive session, that group listened attentively for more than five hours this week while Col. John H. Leavell, American oil attache in the Middle East, outlined the political and economic consequences of U. S. participation in oil operations in that area and advised that this country commit itself only after the most careful sort of consideration.

While Col. Leavell's testimony was "off the record", it was learned that he took the position that, while the proposed Trans-Arabian pipe line might have been wise two years ago for military reasons, the war has since moved on, leaving a variety of new problems that must be appraised.

Vinson Meets Knowlton, Davies on Subsidy

NPN News Bureau

WASHINGTON — Deputy PAW Davies and PAW Production Director Knowlton met April 4 with Economic Stabilizer Vinson and held what was termed as a preliminary discussion before final submission to PAW of OPA's recommendations on stripper well and secondary recovery subsidy payments by the government.

Indicative of Mr. Vinson's desire for early decision on the plan was his promise to transmit it to PAW within a few days. No detailed study was made at this week's meeting, it is thought, since it is believed that PAW officials have been rather in the dark as to details of the plan.

In addition to a plan dealing with stripper well "premium payments" OPA's recommendations to Mr. Vinson also suggest a 75c a barrel increase in cases where secondary recovery operations are feasible throughout the country.

The secondary recovery proposal was left pretty much "up in the air" by OPA however, which recommended that the question might better be settled after the stripper well "premium payments problem had been threshed out.

Whether Vinson will call in representatives of industry to get their thought is not yet definite. It is considered likely however that he may take advantage of the P. I. W. C. monthly meeting this week to get industry representatives' viewpoint, particularly from those intimate with production operations and problems.

° ° °

Texans Put Gain by Subsidy At Only $40,605 Daily

Special to NPN

AUSTIN, TEX.—Railroad Commissioner Beauford Jester has estimated that the proposed federal subsidy of 35 cents per barrel on production of the nation's stripper wells would add $40,605 daily to the income of these wells in Texas.

The Commission's estimate, made for the research and co-ordinating committee of the Interstate Oil Compact Commission, was based on 35,151 stripper or marginal wells in the state as of March 1 with an average daily production of 3.3 barrels. Total production would be 116,010 barrels per day and an average price of $1.12 per barrel would place total value of production at $129,933 daily. The proposed subsidy would increase average value to $1.47 and total value to $170,538.

15 Months More of War, and U. S. Postwar Gasoline Use Will Be Only 75% of Normal, Chemists Told

NPN News Bureau

CLEVELAND—Only 75% of the prewar volume of gasoline consumed will be required in the immediate postwar period if the present conflict extends much beyond mid-1945, according to a paper on "Factors Relating to Postwar Motor Gasolines," which was to be presented April 5 before the Petroleum Division of the American Chemical Society.

Meetings of the Petroleum Division were in conjunction with the parent group's 107th national meeting in Cleveland this week.

President of A.C.S. is Thomas Midgley, Jr., vice-president of Ethyl Corp. and well-known in the petroleum field for his work in developing the use of tetraethyl lead in gasoline.

Chairman of the Petroleum Division is C. L. Brown, research director at the Baton Rouge refinery of Standard Oil Co. (Louisiana). Dr. R. E. Burk, research director for Standard Oil Co. (Ohio), is vice-chairman.

The talk on the postwar gasoline picture was scheduled to be given at the opening session of the group's meeting by B. H. Weil and Alberta H. Adams, of the Information Section, Chemistry Division, Gulf Research and Development Co., Pittsburgh.

Fewer Autos—If War Lasts

Estimates of the postwar gasoline requirements are based on predictions that few more than 15,000,000 automobiles, scarcely more than half of the nearly 30,000,000 on the road in 1941, will be in serviceable condition at the cessation of hostilities if the war extends much beyond the summer of 1945.

While the reduction in cars that would be in use at that time is estimated to be nearly 50%, many of those lost would be of the type which normally sees comparatively little operation, accounting for only a 25% drop in gasoline requirements.

Regarding quality of postwar gasolines, the abstract states that they "will have A.S.T.M. octane numbers between 75 and 80 for the regular or 'housebrand' gasolines and between 85 and 88 for the premium grades of gasoline. The latter will constitute a higher percentage of the market than it did in the past, both because of habits developed during the war and the need for higher octane fuels for old engines, of which there will be a considerable number.

"Whether the octane numbers will progressively increase above these figures is an indeterminate question at the present . . . but it does not seem probable that 100-octane fuels will soon play an important part in the automotive field."

"Combustible Gases as Substitute Motor Fuels" was the subject of another paper, to be presented before the Petroleum Division by Dr. Gustav Egloff, research director, and Mary Alexander, both of Universal Oil Products Co., Chicago.

According to the abstract of Dr. Egloff's talk, over 165,000 motor vehicles in Europe and America now operate on combustible gases — methane, ethane, propane, n-butane, isobutane, acetylene, hydrogen, ammonia. This figure includes 25,000 busses, trucks, and other heavy-duty vehicles in the United States, particularly in the far west.

Dr. Thomas Midgley Jr. . . . president, American Chemical Society

Dr. R. E. Burk . . . vice president, division of petroleum chemistry, American Chemical Society

Dr. Egloff estimated that motor fuel equivalent to 1,161,000,000 barrels of gasoline is potentially available in this country each year from various methane sources. This is roughly twice the actual peacetime consumption of gasoline, which, in 1941, was 694,600,000 barrels. "If driven by necessity to use methane as motor fuel," Dr. Egloff states, "the United States could undoubtedly make the change."

Production of gasoline and coal from carbohydrates, abundantly available in plant material and farm wastes, was explained in a paper presented by Dr. Ernst Berl, research professor at the Carnegie Institute of Technology.

According to Dr. Berl, solid, liquid, semi-liquid and gaseous fuels can be produced from such materials as algae, sugar cane, bagasse, molasses, cornstalks, corncobs, seaweed, Irish moss, wood, sawdust, and the like. From 100 long tons of Louisiana dry sugar cane, he reports, the process will make 2980 gallons of gasoline, 3430 gallons of middle oil and 1210 gallons of lubricating oil, in addition to over eight tons of raw cane sugar.

The process is relatively cheap and simple, Dr. Berl asserts. By carefully controlled internal combustion a material called "protoproduct" can be made; gasoline, kerosine and lubricating oil can then be obtained by hydrogenation.

Fatal Accidents in Home Top War Toll, Safety Group Told

NPN News Bureau

NEW YORK—For every soldier killed in battle between Pearl Harbor and Jan. 1, 1944, six civilians died from accidents in the home, Roy S. Bonsib, safety director of Standard Oil Co. (N. J.) said in an address before the petroleum section of the 15th annual Greater New York Safety Convention March 30.

Mr. Bonsib, chairman of the Off-the-Job Safety Committee, Petroleum Section of the National Safety Council, said that, in terms of time lost to war production, home accidents in one year had the effect of shutting 60 factories each employing 1000 workers for one year, a total of 60,000 man-years lost in one year.

The National Safety Council reported that of 41,500 accidental deaths of workers in 1943, 23,500 were off the job.

Mr. Bonsib cited Colonial Beacon Oil Co. as an example where industrial safety was offset by off-the-job accidents. In a two-year period, he said, in which the company suffered no disabling industrial accident, 37 off-the-job accidents were reported, causing employes to lose 646 days.

John M. Roche, director of the Industrial Division of the National Safety Council, Chicago, spoke on "How the National Safety Council Can Help the Petroleum Industry".

Gulf A.I.M.E. Unit to Meet

Special to NPN

HOUSTON, Texas—The annual meeting of the Gulf Coast region of the American Institute of Mining and Metallurgical Engineers will be held here May 8, 9 and 10, I. W. Alcorn, production engineer of the Pure Oil Co. and chairman of the Gulf Coast region of the A. I. M. E., has announced.

Decorate 'A' Coupon Holder as Real Patriot on the Home Front

He's Giving Up His Share of Gasoline to Help All Americans and Our Allies Win the War

WHAT people are overlooking in regard to gasoline rationing is that under our Constitution and rules of fair play, ALL car owners are entitled to THEIR PRO RATA SHARE of motor fuel.

BUT, to carry out their desire to help win the war, some of these car owners are giving a large part of "their share" of motor fuel to those car owners who say they must have MORE than "their share" in order to give their personal efforts to the war.

This means that at least the holders of only "A" coupons are truly patriotic and sacrificing citizens because they are giving up so much of their own gasoline to the holders of "B", "C" and other larger coupons to help the war effort for all Americans and our Allies.

Therefore, it would seem to follow, that the "A" coupon holders should have a great deal to say, not only as to how much gasoline they give up, but as to who gets the "A" holders' share and what the recipient does with it?

Hence it might seem reasonable to ask of all the "A" holders their consent before "taking their property" away from them. Ask the "A" holders—and there are about 8,000,000 to 10,000,000 of them, OPA estimates—if they are satisfied with the way their fellow citizens, the "B", "C" and "R" and "T" coupon holders are using the "A" man's gasoline?

If the "A" holders could be aroused to their just rights under our laws and the Constitution, maybe the gasoline rationing inequities would be fairly easily and quickly straightened out, because 10,000,000 American citizens and their families, who also have contributed this extra gasoline to the "B" and "C" car owners, can make a mighty noise once they are aware of their number and strength and aroused to the injustices—if any—being imposed upon them by a heartless (?) and selfish (?) and hoggish (?) majority.

Like some other things during this war and the reign of the professors at Washington, the government has just gone ahead taking gasoline from "those who have" for those "who have not." That is the way the professors have taken most other things. In fact as to gasoline, the professors have refused to recognize that these particular "haves" at any time really, had any right to own cars because such ownership not only evidenced possession of some extra or idle money, but these "haves" were using the cars for "pleasure", going to golf clubs, shopping and other "non productive" errands.

So when the war started passenger cars that were not used by the "hard working war workers" were simply "pleasure" cars and had no rights on the road. From their high positions in a "socialist state" atmosphere at Washington, the professors said that the war was the justification for depriving these "pleasure seekers" of what did "not belong" to them and so the professors made them "A" coupon holders.

All the talk and statements and orders at Washington regarding gasoline, have been from the point of view that the gasoline either "belonged" to the government—which is pure socialistic thinking—or that those who allege they are "in war work" have first claim on all gasoline under our "war powers."

But, we submit, the facts and the laws are that the gasoline which has been given these alleged "war workers" above their fair share, does not "belong" to those workers, nor to the government, but actually belongs to the "A" coupon holders who, out of love of country, have given up this gasoline just as they give up their money and their sons for the success of the war.

If gasoline rationing were approached from this point of view it should have the following results:

1—An acknowledgement that the government is fair in admitting the "A" coupon holders' "right" to this gasoline.

2—Putting the "A" coupon holder in the position of having given his gasoline for war purposes would arouse in him a sense of pride and high patriotism.

3—Such realization of having given of what is "his", would cause the "A" coupon holders to scrutinize the use to which the "B" and "C" and other coupon holders are putting the "A" man's gasoline to the end that there would be some actual and probably most effective person-to-person policing of this use, or mis-use.

4—Telling the public, meaning the "B", "C" and other coupon holders, of the patriotic sacrifice and generous giving by the "A" man of "his share" of the gasoline to them, should shame some of them into a more careful use of the gasoline.

5—And, to cap it all, give the "A" coupon holder, not just a plain, little, smudgily printed "A" sticker for his windshield, but a specially designed and printed "A" coupon that will be decidedly different from the "B" and "C" and other stickers. This dolled up "A" sticker then will tell the world that this car owner has been singled out by the high authorities at Washington and especially decorated for his patriotic and generous contribution of "his share" of the gasoline to his fellow citizen who says he is "in war work."

Make it a misdemeanor to issue an "A" sticker to any one having other coupons and a misdemeanor to display an "A" sticker with any other coupons.

If the government does not want to get up these "patriotic" stickers, maybe some oil companies will do it and hand them to their customers. Or, better still, sell them for a dollar or $5 each and give the proceeds to the Red Cross.

Up to the present moment, the government and every one else has made a great-to-do over the man who says he is "in war work." The car owner with a "B" or "C" sticker frequently has taken it as a mark of distinction, just as some of them sport fancy tags of phony state offices or as pseudo "deputy sheriffs" and which told the world, so they thought, that they could violate all traffic laws.

Police complain today about the smart-aleck driving of young war workers with their "B" and "C" stickers—special privilege insignia to them.

All of us also have seen a lot of cars parked where we know there isn't any war work but which sport "B" and "C" coupons. We also know that some of our acquaintances whom we do not consider "war workers" nor their businesses as specially "essential", also have "B" and "C" stickers. Then there are the young people sporting around because of "B" and "C" coupons and stickers. And what stickers do you see the most of on cars at moving picture parking lots?

All these are today a "privileged" class and too many of them, we know, are running hog-wild both in their claims for extra gasoline and in their mis-use of it.

NPN's suggestion is to make those who GIVE UP this extra gasoline the "privileged" class. These are the ones who make a real sacrifice and a great many of them are doing it voluntarily because, even though their daily work is also "essential" under all government regulations, they are inconveniencing themselves to use public conveyances, or giving up comfortable trips to club or the movies in order that the "real war workers" may get this extra gasoline.

Make it a distinction and a privilege to join this highly patriotic group so that every one—who is fit to live in this fine and still free land—will strive earnestly and sincerely and honestly to qualify to be an "A" coupon holder.

Hochuli Stands Crossfire, Indicates Order Is Near As Dist. 1 Points Faults of PAO 1 (Now PDO 1)

NPN News Bureau

NEW YORK — Dist. 1 has recommended to PAW that Sec. C (2) (ii) of the new PAO 1 (now officially PDO 1) be eliminated and that the entire proposed order be held up for further study before issuance. (In the earlier version, the section objected to was designated as Sec. C (2)—The Editor).

The recommendation came out of the joint meeting here March 31 of the District Marketing Committee and the S. & D. Committee, attended by members of the Marketing Committee's three jobber and dealer subcommittees. It was the most representative group yet assembled in Dist. 1 to discuss the proposed order, and in a hard-hitting four-hour session, representatives of all strata of the industry fired their questions and objections at PAW National Marketing Director Hochuli, who was present as the war agency's spokesman.

Wide differences of opinion were voiced, but it was evident that the entire industry represented was opposed to the order in its present form, since it was criticized by major and independent, by jobber and dealer.

In fact, the only support of the order as now written came from Mr. Hochuli and PAW's chief counsel, Wallace E. Avery. All the critics emphasized, however, that they were not opposed to a distribution order—merely to certain features of the one proposed.

Mr. Hochuli opened the session with the statement "We're not trying to force this on you." He said the order had already had wide publicity since it was given to the industry for study on Feb. 29, and that presumably enough time had elapsed for thorough consideration by all interested groups. He emphasized what he termed the representative character of the order, pointing out that from Dist. 1 had come 17 suggestions for modification, of which 10 had been adopted. Other changes have been incorporated from the other four districts, he said.

Hochuli's Main Points

In his initial presentation Mr. Hochuli stressed:

1. The designation of the order has been changed; it is no longer PAO 1 but is now known as PDO 1 (Petroleum Distribution Order).

2. This change in title emphasizes that the order is concerned with distribution only, not supply.

3. PAW is reluctant to allow more time for industry consideration. Need for the order is urgent and longer delay in instituting it does not appear justifiable.

4. The proposed PDO 1 in its revised form already has gone to the WPB for approval.

There are two main changes in the revised form compared with the originally proposed text (*See NPN, March 15, page 46*):

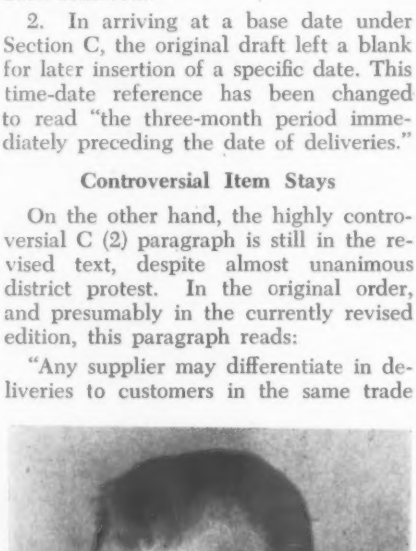
1. The entire Section D, relating to inventory restrictions in Dist. 1, has been removed.

2. In arriving at a base date under Section C, the original draft left a blank for later insertion of a specific date. This time-date reference has been changed to read "the three-month period immediately preceding the date of deliveries."

Controversial Item Stays

On the other hand, the highly controversial C (2) paragraph is still in the revised text, despite almost unanimous district protest. In the original order, and presumably in the currently revised edition, this paragraph reads:

"Any supplier may differentiate in deliveries to customers in the same trade area in accordance with the relative essentiality of the functions or services performed by such customers, *provided* that such supplier shall not differentiate or discriminate in deliveries to customers performing the same functions or services and that such supplier shall consider all service stations and other retail outlets as performing the same functions or services."



Walter Hochuli . . . thought there should be no delay

Mr. Hochuli stressed that discussion of PDO 1 must be strictly divorced from that of Directive 59, but that was challenged by Jacob Blaustein, vice-chairman of the Marketing Committee and the S. & D. Committee, and chairman of the meeting. "PDO 1 must work with Directive 59 to the extent that '59' is affected by it," he replied. Mr. Hochuli took the position that questions under '59' had no place at the parley. "We can't correct any inequalities in Directive 59 through PDO 1," he said.

Mr. Blaustein's position was supported by Willard Wright, manager of Dist. 1's S. & D. operating group and author of the Wright plan for the definition of "current ration demand". Mr. Wright said he was "concerned" over how it would be possible to make the redistribution clause of '59' work in connection with the proposed PDO 1, since the order requires disregarding a company's preferential accounts.

A main point of criticism against the proposed order in its present form was expressed by Mr. Blaustein and others: PDO 1 permits a different treatment of jobbers by different companies, even though it requires the same treatment by one company of all its jobbers. Reflected down to the dealer level, for instance, this means that four service stations on four corners of an intersection can all be receiving different amounts of supplies, and such a situation can put out of business the dealer who is at the disadvantage.

"Essentiality" Is Issue

Another criticism was directed against the method of determining essentiality of customers. That determination, in the first instance, is left to the supplier, but under such procedure, it was argued, a definition of "essential use" can be made such that it covers all of a supplier's product, hence leaving none for reassignment. Walter Faust of Socony-Vacuum contended that such a method of determining essentiality "will cause discrimination all the way down the line."

Mr. Hochuli explained that PAW regards PDO 1 as a flexible, general order, and expects to issue interpretations under it covering particular questions as they arise. "Probably we'll have 200 to 300 interpretations," he said. "It's likely we'll have 40 to 50 in the first 60 days under it."

John Scott of Buckley & Scott Utilities Co., Watertown, Mass., a member of the S. & D. Committee, argued that "action by interpretation" is impractical in cases of fuel oil shortage in severe cold weather crises where relief must be a matter of hours at most.

A knotty question was presented in the definition of the term "trade area". It was generally agreed that a definition was needed, but little agreement was evidenced as to what it should include.

Mr. Hochuli and Mr. Blaustein both insisted that historical position was not legally possible in the order despite the pleas for it from many quarters. Mr. Hochuli said: "We tried that, and we took the damndest beating trying to make a historical basis stick. WPB just won't allow it."

Mr. Hochuli summed up the consensus of the meeting by saying it appeared to him that dealers or jobbers present thought they would not be benefited by the order to the extent that they should be, but that many admitted they wouldn't be hurt by it. "We can't do everything," Mr. Hochuli said. "This order won't correct every evil. But how

many jobbers feel they will be better off under it in some way?"

To all pleas that PAW hold up issuing the order, Mr. Hochuli refused a commitment. He indicated that PAW feels the order has had sufficient discussion and is prepared to see it through quickly.

Following is the complete text of revised PDO 1, formerly known as PAO 1:

The fulfillment of requirements for the defense of the United States has created in certain areas a shortage in the supply of motor fuel and fuel oil for defense, for private account and for export; and the following Order is deemed necessary and appropriate in the public interest to promote the national defense and to provide adequate supplies of motor fuel and fuel oil for military and other essential uses.

Petroleum Administrative Order No. 1 is hereby amended and re-issued as follows:

Section 1529.3 Petroleum Distribution Order No. 1.

(a) Definitions.

(1) "Person" means any individual, partnership, association, business trust, corporation, governmental corporation or agency, or any organized group of persons, whether incorporated or not.

(2) "Motor fuel" means liquid fuel, including Diesel fuel, used for the propulsion of motor vehicles or motor boats and shall include any individual grade of liquid fuel to which Federal gasoline taxes apply except liquid fuel used for the propulsion of aircraft.

(3) "Fuel oil" means any liquid petroleum product commonly known as fuel oil including Grades Nos. 1, 2, 3, 4, 5, and 6, Bunker "C", Diesel fuel, kerosine, range oil, gas oil, or any liquid petroleum product used for the same purposes as the above designated grades.

(4) "Supplier" means any person other than a service station or other fixed retail outlet who refines or receives delivery of motor fuel or fuel oil for redelivery to others, and includes, but is not limited to, any secondary supplier.

(5) "Customer" means any person other than a supplier who receives motor fuel or fuel oil from any supplier, and includes a service station or other fixed retail outlet.

(b) Deliveries for Specified Uses.

Each supplier, within the limits of his supply, shall make withdrawal or delivery of motor fuel or fuel oil when such withdrawal or delivery is requested to satisfy the requirements of:

(1) The Army, Navy, Marine Corps, Coast Guard, War Shipping Administration, United States Maritime Commission, Treasury Procurement Office, Federal Economic Administration, and vessels of the United Nations.

(2) Any person using or supplying motor fuel for non-highway farm uses who presents valid "E" or "R" coupons or ration checks, issued pursuant to Ration Order 5C of the Office of Price Administration, to the extent of such uses only.

(3) Any person to whom such supplier is directed to supply motor fuel or fuel oil by directives issued by the Petroleum Administration for War.

(c) Deliveries for Other Uses.

(1) After making provision for the deliveries of motor fuel or fuel oil specified in paragraph (b), each supplier shall be obliged to make deliveries of remaining supplies of motor fuel or fuel oil in such manner as will satisfy the current requirements of customers and other suppliers in the same trade area, who, during the three month period immediately preceding the date of deliveries currently being made, were regularly supplied directly or indirectly by him, or whom he has been directed to supply under paragraph (d) hereof.

(2) If, after making provision for the deliveries of motor fuel or fuel oil specified in paragraph (b) any supplier is unable to satisfy the current requirements of customers and other suppliers in the same trade area, who, during the three month period immediately preceding the date of deliveries currently being made, were regularly supplied directly or indirectly by him, or whom he has been directed to supply under paragraph (d) hereof, such supplier shall apportion all available supplies of motor fuel and fuel oil fairly and equitably in such manner as will satisfy as nearly as possible the current requirements of such customers and other suppliers in the same trade area, in accordance with the following standards:

(i) Except as provided in subparagraphs (ii) and (iii) hereof, no differentiation or discrimination shall be made in the same trade area because of trade classification, affiliation, ownership, operation, control, size, purchasing or selling methods, location, accessibility to transportation facilities, imposition of special conditions not imposed on all customers and other suppliers in the same trade area, or for any other such reason.

(ii) Any supplier may differentiate in deliveries to customers in the same trade area in accordance with the relative essentiality of the functions or services performed by such customers: *Provided*, that such supplier shall not differentiate or discriminate in deliveries to customers performing the same functions or services and that such supplier shall consider all service stations and other retail outlets as performing the same functions or services.

(iii) Any supplier may differentiate uniformly in deliveries to customers and other suppliers in the same trade area on the basis of relative inventories expressed in days' supply on hand at such customers' or other suppliers' storage locations.

(iv) If several suppliers are obligated to supply any customer or other supplier with the same grade of motor fuel or fuel oil, each such supplier shall be obligated to satisfy only his proportion of the current requirements of such customer or other supplier on the same percentage basis as he satisfies the current requirements of his undivided accounts performing the same functions, or services.

(d) Directed Deliveries

If any person is unable to obtain deliveries of motor fuel or fuel oil, such person may appeal to the District Director-in-Charge who shall, if he finds that the facts warrant the relief requested, designate one or more suppliers to make deliveries to such person and the supplier or suppliers so designated shall make such deliveries as directed.

(e) Appeals.

Any person affected by this Order who considers that compliance therewith would work an exceptional and unreasonable hardship upon him may file an appeal setting forth the pertinent facts and the reasons why he considers himself entitled to relief.

All correspondents and all appeals filed under paragraph (d) or under this paragraph shall, unless otherwise directed, be addressed to the District Director of Distribution and Marketing, Petroleum Administration for War at:

(1) 122 East 42nd Street, New York, New York, if the motor fuel or fuel oil is to be delivered or used in the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Pennsylvania, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, or Florida, or the District of Columbia.

(2) 1200 Blum Building, 624 South Michigan Avenue, Chicago, Illinois, if the motor fuel or fuel oil is to be delivered or used in the States of Ohio, Kentucky, Tennessee, Indiana, Michigan, Illinois, Wisconsin, Minnesota, Iowa, Missouri, Oklahoma, Kansas, Nebraska, South Dakota, or North Dakota.

(3) 234 Mellie Esperson Building, Houston, Texas, if the motor fuel or fuel oil is to be delivered or used in the States of Alabama, Mississippi, Louisiana, Arkansas, Texas, or New Mexico.

(4) 320 First National Bank Building, Denver, Colorado, if the motor fuel or fuel oil is to be delivered or used in the States of Montana, Wyoming, Colorado, Utah, or Idaho.

(5) 855 Subway Terminal Building, Los Angeles, California, if the motor fuel or fuel oil is to be delivered or used in the States of Arizona, California, Nevada, Oregon, or Washington, or the Territories of Alaska or Hawaii.

(f) Violations.

Any person who wilfully violates any provision of this Order or who, by any act or omission, falsifies records kept or information furnished in connection with this Order is guilty of a crime and upon conviction may be punished by fine or imprisonment.

Any person who wilfully violates any provision of this Order may be prohibited from delivering or receiving any material under priority control, or such other action may be taken as is deemed appropriate.

'Bogus' Coupon Baffles OPA—Enforcement Faces Test

Special to NPN

BALTIMORE—Legal challenge of OPA's enforcement policy is under way here in a case which may seriously affect the agency's current nation-wide campaign against the black market.

Four gasoline dealers here were haled before OPA on counterfeit charge-back accusations, but investigation by one of the dealers showed that the alleged counterfeit coupon had come from a Maryland state department. The dealers obtained that ration book and OPA enforcement officials called it counterfeit.

Then examination was made of another non-issued book and the same blurred printing was noted on that book which had formed the basis for charges against the dealers. OPA enforcement officers reversed their verdict and declared all the coupons non-counterfeit.

Harry R. Wainwright, executive director of the Gasoline Retailers Assn. of Washington and Baltimore, then called in John Dressler of New Jersey, president of the Eastern States Gasoline Dealers Assn. and Eastern Seaboard advisor to OPA. A lawyer was employed who ordered immediate impounding of the coupons and ration books involved, and a legal case is being prepared which contends that, since OPA itself cannot distinguish counterfeit from genuine coupons, no basis for determining such distinction exists and hence all prosecutions based on such determination are invalid.

Parsons Named to PAW Post Replacing Frank Watts

NPN News Bureau

WASHINGTON—PAW March 31 announced the appointment of Claude P. Parsons as materials division director succeeding Frank A. Watts, who resigned last week to return to Humble Oil and Refining Co. as general purchasing agent.

Mr. Parsons has been with PAW as assistant director of the division since January. He is on leave from Halliburton Oil Well Cementing Co., of which he is vice-president. His knowledge of petroleum industry materials is based on 25 years' experience working with operating materials, equipment and methods. Previous to his association with Halliburton, Mr. Parsons was connected with Magnolia Petroleum Co., beginning in 1919 as a roustabout and working up to the post of district superintendent in Oklahoma.

Talk of Ration Changes Premature, Houston Says; (but 'B' Books for 'in Work' Driving Might Gain)

By James Collins
NPN Staff Writer

WASHINGTON—There appears now to be a very good chance that "B" gasoline rations will be increased sometime soon for those who need more gasoline in the course of their work. If this does develop however—and officials emphasize this point strongly—it will not mean that there is a greater supply of gasoline but rather that OPA has tightened its controls over quotas already assigned.

Pointing up the confusion, meantime, on possible increase or reduction of gasoline rations in the near future were two newspaper stories, one in the New York Times and the other in many other papers under an Associated Press dateline. The first story was headed: " 'B' Gas Is Slated for the Next Cut," while the second story's headlines generally carried the message: " 'B' Coupon Value to be Increased." Both stories quoted liberally the reported words of Col. Bryan Houston, OPA rationing chief.

Although quite intimately acquainted with the details surrounding gasoline rationing, NPN's eyes popped, as others must have, at the two newspaper stories. Puzzled as to just what was cooking on the gasoline rationing front, NPN sat down with Col. Houston and got the following facts:

All talk of changes in the ceiling of "B" gasoline rations is "premature", said Col. Houston, adding: "We will continue to ration all the gasoline there is available under our quota. We are as near as it is humanly possible to be on the quota of gasoline now allocated to us for rationing nation wide. Perhaps we are slightly over, but not materially.

"If the present gasoline setup results in any more gasoline being available, for anyone, it should, in my opinion, go first to those people who need it for driving in the course of their work."

These following points were made clear:

1. OPA hopes that as a result of steps outlined below, it may become possible during the second quarter to improve the ceiling on "in-work" driving under "B" rations, as distinguished from "home-to-work" allowances under the "B" card.

2. OPA's "conservative" estimate is that about 50,000 b/d of gasoline will be siphoned from the black market into legitimate channels by the ban on exchange of "R" non-highway coupons at filling stations—except under certain conditions—which went into effect April 1.

3. Added to this 50,000 b/d, probably another 20,000 b/d will be squeezed out from the recent rearrangement between "A" and "B" coupons in the four districts west of the East Coast.

4. If the above 70,000 b/d savings do result, the first rations that OPA will increase will be those for "in-work" driving under the "B" coupon. OPA's goal on this is to raise "in-work" ceilings to a uniform 720 miles monthly nation wide. Judging from careful discussions with trade associations and other groups, this mileage would be about 60% of normal for such drivers. ("In-work" driving ceilings under "B" rations are now 325 miles monthly in Dist. 1, 475 Dists. 2, 3 and 4, and 400 miles monthly in Dist. 5).

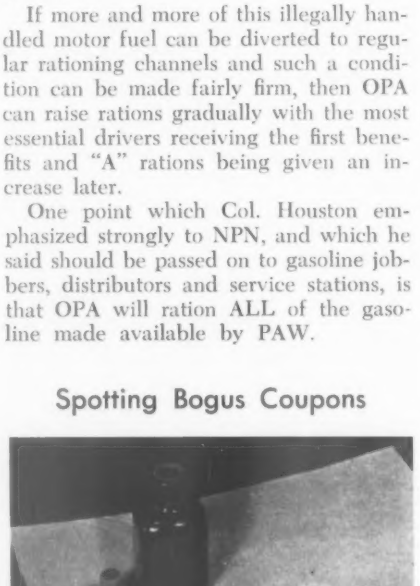
5. If there is any further improvement—that is if substantially more than 70,000 b/d is saved as outlined in points 2 and 3 above—then OPA's next action will be to raise "A" rations, now worth only two gallons weekly nation wide. However, it is doubtful whether there will be any such further improvement.

OPA's reasoning is fairly simple. While a quota of 1,257,000 b/d of gasoline has been allocated by PAW for OPA for civilian rationing during April, May and June, it is well known that out of this total literally hundreds of thousands of gallons are daily leaking into the black market thus making it necessary for OPA to trim gasoline rations for the honest and dishonest alike in order to stay within quota.

If more and more of this illegally handled motor fuel can be diverted to regular rationing channels and such a condition can be made fairly firm, then OPA can raise rations gradually with the most essential drivers receiving the first benefits and "A" rations being given an increase later.

One point which Col. Houston emphasized strongly to NPN, and which he said should be passed on to gasoline jobbers, distributors and service stations, is that OPA will ration ALL of the gasoline made available by PAW.

Spotting Bogus Coupons



Government gasoline ration paper after the chlorox test used by OPA. Chlorox, a common household bleaching agent, rubbed on the back of the paper, brings out the invisible watermark

WAR OIL NEWS from WASHINGTON

HERBERT YOCOM *Bureau Chief*
NATIONAL PRESS BLDG.
NATIONAL 3477

Dean Named Economic Advisor On OPA Price Staff

NPN News Bureau

WASHINGTON — Joel Dean, until March 18 head of OPA's fuel rationing division, will assume the post of economic advisor on reconversion price problems, on staff of OPA Price Deputy James F. Brownlee, when he returns from vacation in Atlanta, Ga., April 3.

Mr. Dean came to OPA in July, 1941, from post of professor of school of business of Chicago University. First job was as price executive of OPA's industrial machinery section. In March, 1942, he was appointed chief of gasoline rationing division, just set up, later becoming director of fuel rationing.

Feb. 'Gas' Tax Take Rises 25% Above a Year Ago

NPN News Bureau

WASHINGTON—Federal gasoline tax collections totaled $19,110,966 during February, compared with $15,279,059 during the same month of 1943 or an increase of about 25%, according to an Internal Revenue Bureau report March 29.

Showing even greater increase were tax collections on lubricating oils, which totaled $6,118,862 as compared with $3,030,578 for February 1943, or an increase of over 101%.

Gasoline tax receipts from July 1, 1943 to Feb. 29, 1944, totaled $181,803,565 compared with $209,269,675 for the same period previous to that, or a drop of 13.1%. Comparative tax figures on pipe line transportation were: July 1, 1943-Feb. 29, 1944, $10,226,827, compared with $9,252,409, or an increase of 10.5%.

Sessions Assumes PRC Post

NPN News Bureau

WASHINGTON—Gordon M. Sessions, PAW public relations director, is quitting that post to take a similar position with Petroleum Reserves Corp.

PRC relations with both press and industry have been notoriously bad and Sessions' job is expected to be primarily that of explaining objectives of the Government-owned corporation and reasons for entrance into Arabian pipeline deal.

No Gasoline Ration Boost for Anybody, Ickes Says; Cites Narrowing U. S. Supply; Davies Backs Him

WASHINGTON — PAW this week spiked talk of a possible relaxation in gasoline rationing regulations by proclaiming bluntly: "There is no possibility at this time of increasing the gasoline supplies for civilian motorists in any section of the country."

Issuance of the PAW statement was prompted by published reports in New York that supply conditions along the Atlantic Seaboard were now such that "drastic rationing" of gasoline and other products "is no longer necessary."

"There is not enough gasoline in the East Coast, or in any other section of the U. S., for that matter," said PAW Ickes, "to permit an increase in the present gasoline allocations for civilian automotive uses. Despite any statements made by so-called 'informed sources' stocks of gasoline for civilian use are tight all over the country."

Meanwhile OPA Rationing Chief Houston in an exclusive interview with NPN said that talk of changes in the "B" coupon ceiling was premature, conceded that eventually it may be possible to allot "in-work" "B" card holders extra rations, not through allotment of additional supplies but through savings accomplished by stricter enforcement. (*See p.* 8).

"Stocks at 20-Year Low"

"Stocks of total crude petroleum and products in the U. S. are at the lowest level they have been in the last 20 years," Mr. Ickes said.

"The allocations for the second quarter of 1944 have been made to the OPA. It is not expected that these will be changed."

(The New York reports were attributed not to "informed sources", as PAW Ickes indicated, but to "oil executives," a "few" of whom were said by the *New York Times* to maintain "that rationing of gasoline should be discontinued, and competitive conditions restored in the industry.")

Backing up Mr. Ickes, Deputy PAW Davies pointed out that, while East Coast stocks are generally better than a year ago, "this does not mean there is an abundance of gasoline supplies. We are merely in a better working position in this area now, and thus may be able to avoid the serious shortages that constantly plagued us all last summer."

"Supply Main Issue"

He added:

"We do not now foresee any substantial easing of the situation. Military demands have been mounting steadily and continue to increase. The more we supply to the military, the less is available for civilians.

"When discussing stock positions in any section of the country, one cannot separate that section from the remainder of the Nation. Now that the two big pipelines are operating from Texas to the East Coast, the transportation problem has eased somewhat. Our current problem is primarily one of supply. That means that no section of the country is independent of the other.

"The U. S. must be considered as a unit to the extent that transportation is sufficient to permit the equitable distribution of supplies. This particularly applies to the East Coast, which is dependent upon other areas for its supplies.

"While inventories of crude petroleum and petroleum products in the country declined 13% during the last two years, gasoline inventories, (including military gasolines) decreased 20%. Since aviation and other military gasolines were increasing during this period, obviously stocks of civilian gasoline have declined even more than published figures indicate.

"Instead of considering increasing the allocation of gasoline for civilians at this time, the PAW and the petroleum industry are having all they can do to meet the programmed requirements as allocated to the OPA for the second quarter of 1944."

Counterfeits Turn Dark Under Ultra Violet Rays

When this deposit sheet is held under the ultra-violet lamp, the good coupons shine—but the four counterfeits turn black, OPA investigators report

PAW Materials Director, Quitting Post, Optimistic On Tubular Goods and Engines, Hopeful on Trucks

NPN News Bureau

WASHINGTON — A strong note of confidence as to future supply of oil country tubular goods was expressed today to P.I.W.C.'s production committee by Frank A. Watts, who recently resigned as PAW materials director, in his last report.

Mr. Watts also predicted an increasing flow of internal combustion engines and parts to oil field distributors and revealed that PAW is now conducting a survey in all five districts to determine truck needs of petroleum operators other than those engaged in transport or marketing.

There is no indication, Mr. Watts said, that the supply of oil country tubular goods will not be sufficient for uninterrupted domestic drilling operations, "even though the rate may continue to accelerate." Unless some unforeseen military program develops, he added, material allotments to PAW will be high enough to provide tubular material required for all drilling programs.

He cautioned, however, that recent elimination of form PAW-35 filing requirement makes it particularly important that as many production operators as possible prepare and file purchase orders three to three and one-half months in advance of the quarter in which the material is to be delivered. These purchase orders should be prepared and placed only when, and to the extent, an operator has a known need for a planned operation.

"Pipe Supply Adequate"

Although supply and demand of drill pipe reached a "rather delicate position" in the last six months of 1943, Mr. Watts observed, drill pipe is now being produced at a rate slightly in excess of net requirements.

"There is no known reason why it will be necessary to delay any drilling operation for lack of drill pipe," he continued, "provided operators make plans reasonably well into the future. The present backlog of orders for tool joints is 220,000. Even so, the supply is being gradually increased, and the cooperation of the production operators and tool joint manufacturers has prevented—and will continue to prevent—any serious delays in drilling operations. Tool joints are now being manufactured and delivered at a rate which slightly exceeds the rate at which they are being worn out."

Since over-all supply and demand of oil country tubular goods is so nearly in balance, Mr. Watts pointed out, it will not be possible always for an operator to obtain material from his regular pipe mill by the time material is required for use. There will be one or more mills, however, he added, which will be able to accept the order.

Regarding new internal combustion engines and parts, Mr. Watts said that, while there continues to be a far greater demand than supply, "an occasional bright spot is beginning to break through a sky which has been extremely cloudy." Engine parts are actually beginning to move to oil field engine distributors at a steadily increasing rate. Unless there is some unpredictable interference, the day is not far distant when parts for the oil industry's 70,000 or more internal combustion engines will begin to move to distributors at rates equal to actual requirements.

He urged continued co-operation by all operators during the transition period from an under-supply to a balanced supply of engine parts. As soon as it is apparent that parts can be obtained from established distributors, he added, operators are urged to reduce or cancel orders for parts which they have placed with engine manufacturers. This, he pointed out, will avoid a duplication of stocks.

"Engines Enough for 1944"

Unless some unpredictable hitch develops, Watts said, it now appears that sufficient new engines can and will be delivered during 1944 to prevent any serious disruptions in oil operations.

"Here again," he pointed out, "the engine distributors and the engine manufacturers must carry the ball. Operators must place orders just as far into the future as the need is known and must not acquire any engines unless they will be required for use by or shortly after delivery."

The question giving oil operators greatest concern now, Mr. Watts told the committee, is trucks, particularly the heavy-duty type, because, with oil operations steadily on the upgrade, trucks have been rapidly wearing out and repair parts have been unavailable.

At present, he disclosed, PAW is making a survey to determine:

1. Number of trucks primarily engaged in and needed for petroleum and associated operations—other than transport and marketing operations, hauling products either in bulk or containers.

2. Number owned by operators which are stored, but usable, and which could be promptly conditioned and put into service.

3. Absolute minimum which each operator believes he must acquire by July 1 to prevent serious disruptions.

4. Minimum total number which must be acquired by each reporting operator during last six months of the year to prevent serious disruptions or delays.

The survey is being conducted through PAW district offices and operators who receive a form PAW-46 are urged to give PAW the requested information, promptly. This, Mr. Watts said, "will enable ODT, PAW, and WPB to work together and ultimately will make available a sufficient number of trucks to prevent any serious delays in petroleum operations."

Mr. Watts led off his last report with a table comparing PAW's second quarter 1944 allotments with those of previous quarters. Not included was second quarter of 1943 since it was during that period that the production requirements plan was jettisoned in favor of the present controlled materials plan.

PAW's controlled material allotments, he said, "could be woven into a story which would fill several volumes."

OPA To End Tire Inspections, Except Replacements

WASHINGTON—Periodic inspections of passenger auto tires will be discontinued after April 20, OPA announced April 4.

"The tires on cars now in operation have already been examined at least 3 times since inspection program was put into effect on Dec. 1, 1942," OPA Administrator Bowles said.

"As a result, all required repairs, mechanical difficulties and recapping needs which were uncovered have been called to motorists' attention and taken care of."

Mr. Bowles warned: "This does not mean that the tire picture has become any brighter. It simply means that the inspection program has fulfilled its primary objective—to make motorists conscious of the extreme need for tire conservation and care."

New Tire Rules Are Strict

Bowles warned also it is important that motorists retain their tire inspection records because OPA will continue the use of these records in the gasoline program. He pointed out that it will be possible without the periodic inspections to assure replacement only of such tires as are not capable of giving further service and to maintain control of motorists' tires through the serial numbers.

In other words, inspection by an OPA-authorized tire inspector will continue to be required before a ration certificate is issued to replace a tire.

Whenever a car owner wishes to replace a tire, Mr. Bowles said, examination will also show whether that tire is one of the five which he is supposed to have on his car. This will be ascertained by checking the serial numbers against the original serial numbers on file with motorist's local board.

"A shortage of civilian passenger tires still exists and production this year will run below civilian needs," Mr. Bowles said, adding: "According to the latest estimates of the Rubber Director, 22,000,000 tires will be produced for civilians this year compared with more than 34,000,000 new replacement tires produced in 1941. The situation is made even more serious by the disappearance from the markets in many areas of used tires. So, you see, it is apparent that motorists must continue to do everything possible to conserve the tires now on their cars."

Hill Demands Revocation of PAO 11 for Southwest; Knowlton Defends PAW Control Before P.I.W.C.

NPN News Bureau

WASHINGTON—A showdown with PAW on the question of revoking well-spacing restrictions now in force through PAO 11 in the Southwest was in the offing this week as result of a request by George A. Hill, Dist. 3 production committee chairman, and member of P.I.W.C.'s production committee, for a meeting with PAW Ickes and Deputy PAW Davies to ask return of well-spacing authority to four southwestern states —Texas, Louisiana, New Mexico and Arkansas.

At the April 4 meeting of the P.I.W.C. production committee, the group heard a spirited defense of PAO 11 by PAW Production Director Knowlton. As soon as he finished, Mr. Hill told the committee that at a March 27 meeting in Houston, of the Dist. 3 production committee, a resolution was unanimously adopted that PAO 11 restrictions be lifted entirely in the four states named above.

Mr. Hill said this action would enable greater well drilling, resulting in greater reserves, and offset decline from present producing fields. He pointed out that the rate of drilling during January, February and March was 25% under PAW's 24,000-well program rate. He declared that southwestern operators are handicapped by PAO 11 inasmuch as manpower is wasted in preparing and processing applications and drilling time is lost. He also said the four states, all of which have state spacing laws, are better fitted to rule on this question since they are more intimately acquainted with local conditions.

Outlines PAW Viewpoint

In a lengthy defense of PAO 11 and PAW's arguments for its continued existence, Mr. Knowlton made these points:

1—"Even if the optimistic view be accepted that there are available all of the physical requisites for drilling 24,000 wells during this year and in each succeeding year, there is still the inescapable fact that each and every one of these wells must be drilled according to standards which give promise of contributing the largest possible amount of sustained productive capacity."

2—Shortages of manpower, trucks and engines are serious and "it is only in the proportion that they are dissolved that well spacing restrictions can be relaxed."

3—Existence of PAO 11 has exempted operators from WPB regulations having general application. PAO 11 constitutes a pattern under which the oil producer receives preferred treatment under more than a dozen general WPB orders as well as numerous rules of the controlled materials plan.

4—PAW is hopeful that PAO 11 can be steadily relaxed so that wells can be drilled under automatic provisions of the order until PAO 11 "is nothing more than an umbrella to eliminate townlot and graveyard drilling."

5—It has only been because of guarantee of efficient usage of materials that authority was granted to PAW, as a claimant agency, to distribute materials within the industry on a simplified basis. "Elimination of these standards, or even the possibility that they might not be fulfilled, would remove the guarantee of efficient usage, and place the problem of procurement of materials back in the chaotic condition from which it has come."

Uniform Program Essential

6—Revocation of PAO 11 would probably result in all operators having to apply for priorities on each well, or cause petroleum priority ratings again to become mere hunting licenses. "Surely, such a situation would not be desirable."

7—Even if PAO 11 were revoked, "it is reasonably certain that the state agencies would not be left free of federal regulations similar to that imposed by PAO 11. The necessity for a uniform program, national in scope, will still exist, and if PAW fails to perform its duties, then some other federal agency, no doubt, would take over the task in some form or manner."

8—The situation might be different if "we had unlimited productive capacity but we do not have it. There is some excess productive capacity in West Texas but it is more than offset by deficiencies in productive capacity in other parts of the country."

Plan Supplementary Order

"Let me say," Mr. Knowlton concluded, "that the conscientious aim of our entire organization is to work ourselves out of our jobs. However, it is our sincere conviction that the time has not yet come when, from the standpoint of existing national shortages of materials and manpower and the best interest of the war program, we can justifiably relinquish our control over the spacing of wells. . . .

"A supplementary order is being drafted to be effective in North Texas area which will permit five acre spacing down to 1400 feet, 10-acre spacing to 2500 feet and 20-acre spacing to 3500 feet. I feel that this last amendment will permit closer spacing in some of the fields than the operators and the Railroad Commission will want to see and where that is true, the operators and the Commission should get together on field rules. This same thing will happen as other areas are given liberalized rules or as the order is relaxed in general. Then will be the time for the state bodies to come forward as we slack off."

Dewey Requests P.I.W.C. Aid In Tire Recapping Drive

NPN News Bureau

WASHINGTON—Asserting that renewed effort must be made to extend the life of existing tires by repeated recapping because there will not be enough new tires produced during the immediate future, Rubber Director Dewey has appealed to Petroleum Industry War Council for co-operation on this vital conservation problem.

"The P.I.W.C. has been complimented highly for organizing the drive to collect scrap rubber in 1942," Dewey told the council, according to P.I.W.C. Chairman Boyd March 30. "The council was responsible for relieving the worry of whether or not there was in existence sufficient scrap rubber which could be converted into reclaim, which in turn has made it possible to stretch our stockpile of crude rubber before synthetic came into quantity production."

Now, repeated recapping is necessary if essential driving is to be maintained, he said, adding that "I appreciate that the council is again willing to put its shoulder to the wheel and help get this message to the greatest number of people."

Production Manpower Status 'Serious'

NPN News Bureau

WASHINGTON—In a report mainly given over to the shortage of manpower in oil production and exploration, PAW Production Director Knowlton April 4 reported to P.I.W.C.'s production committee that despite "the vigorous pursuit" of every possible avenue, PAW is not assured of any relief on this question and declared that the oil agency feels that the industry generally "has not taken full cognizance of the drastic situation presently existing."

Mr. Knowlton said that indications are that the military is willing to accept a reduction in production schedules in a number of vital programs rather than lower its original manpower figure.

Throughout the past month, Mr. Knowlton said, PAW efforts have been concentrated on the critical manpower shortage with specific regard to drilling crews and technical personnel engaged in exploratory operations.

Worst Yet to Come

"Beyond question," he added, "this situation is most serious and, in my opinion, has not as yet reached its worst stage. Because of recent changes in administration of the selective service law with regard to men under 26 years of age, it is possible that between 60 and 70 of our present geophysical exploratory crews may be eliminated by the loss of these younger technicians to the armed forces. This will mean a reduction of more than 20% in this activity, which is even now being conducted at an inadequate rate. It is obvious that the result will prove discouraging in view of the need for accelerating our discovery and development program."

PIPELINES—*Views of the Industry's Problems a*

Washington— *Military Angle Ignored in Reports of 'Unnecessary' Rationing* —By Herbert Yocom

WASHINGTON — Reports to the effect that supply conditions in Dist. 1 are such now as to enable some relaxing, if not the complete removal, of controls on civilian consumption do not square with the facts, for the following reasons:

Mr. Yocom

1. They ignore completely the military drain on incoming supply.

2. They overlook the fact that, while stocks may be somewhat above those of a year ago, they are still such that any increased civilian demand at this time would result in a rapid wiping out of gains that have been made and a return to the distress levels of the recent past.

3. They are made without seeming knowledge of the fact that the 20-in. pipeline is rapidly being converted to the movement of other than civilian products.

4. They assume an increase in tanker shipments from the Caribbean whereas information now in the possession of PAW points to the exact opposite.

Deputy PAW Davies about hit the nail on the head when he pointed out that, although stocks are generally better than a year ago, the only significance to be attached to that fact is that the industry today is in a better working position than it was then.

Gasoline stocks, for instance, are now about 2,500,000 bbls. above last year. To the uninformed public, that sounds like a lot of gasoline. Actually, in terms of days' supply spread over a year's time, it amounts to something less than 7000 b/d additional supply—a mere drop in the bucket when one considers that a one-gal. per week hike in "B" and "C" coupons would result in a 30-40,000 b/d increase in civilian demand for gasoline on the East Coast.

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Premium Cutback Coming Up

Imposition of controls on the output of civilian premium grade gasoline that may be made by each individual refinery is now definitely in the cards, provided WPB, Justice Department and the military agree with PAW on this.

Effect of the action, if taken, will be to cutback each refinery to its pre-war premium output.

Out the window so far as PAW is concerned is the idea, advanced by OPA, of eliminating premium entirely for civilian use and going to a single war or "victory" grade of gasoline of about 73-74 octane. OPA is reported to have been willing to boost prices on this proposed grade to compensate marketers for loss of premium sales.

Thinking at OPA was that regular grade is now of such "poor quality" that the situation could be improved all around by cutting out premium and manufacturing a single civilian grade that would give somewhat better performance than the regular that is being sold today. Only rub to that was that such a plan might actually result in increasing the drain on the TEL stockpile and defeat PAW in its efforts to conserve lead for use in 100-octane.

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Oil Delegate Twice Knighted

Sir William Brown, who will head up the British oil delegation soon to arrive in this country, has been twice knighted. He is a Knight Commander of the Bath and Knight Commander of St. Michael and St. George. In addition, he may write the initials C. B. E. after his name, meaning that he is also a Commander of the British Empire.

Atlantic Coast— *Open Session with Hochuli Sets Good Precedent* —By Henry Ozanne

NEW YORK—For the first time on March 31 PAW admitted NPN representatives to an important government-industry meeting here—the joint session of the Dist. 1 Marketing Committee and the S. & D. Committee, called for the purpose of discussing with National Marketing Director Hochuli the proposed PAO 1, now renamed PDO 1. Many industry men have expressed to this writer their approval of PAW's action in saving that meeting from the stigma of secrecy, and have voiced their hopes that PAW will see fit to strip the cloak of secrecy from subsequent sessions and transactions.

Mr. Ozanne

As a result of PAW's intelligent handling of that meeting from the standpoint of press relations, it is possible to present a fairer and more comprehensive picture to the industry of PDO 1, its purpose and the objections that have been raised against the order in its present form. This writer was impressed with the competence of Mr. Hochuli's defense of the proposed order, and his obvious sincerity when he announced that Washington is not trying to "put one over" on the industry.

Mr. Hochuli answered all questions frankly and thoroughly, and there is no doubt that much of the complaint against PDO 1 has arisen in misconceptions which the Marketing Director was able to correct. That is all to the good.

But it is also obvious that it is the widespread belief of all sectors of the industry in Dist. 1 that PAW has not yet done the best job possible on PDO 1 and the order should be held up for further study. Mr. Hochuli points out the urgent need for the order and suggests that if the jobber and dealer ranks have not been able to unify their own views in the month the order has been publicized, there may be little expectation they could do so in another month.

That argument is not cogent to this writer on the reports of many members of the Marketing Committee's three subcommittees. Mr. Hochuli assumes that jobbers and dealers have had the unrestricted opportunity to study the order and have studied it in the belief that their judgment will be embodied in the final instrument. On the contrary, the order has been shrouded with secrecy and only select assemblages have had the chance to inspect it. In fact, no publication was given the order except by NPN (*March* 15, *p.* 46) which published the order without the approval of PAW and even over its protest. One instance: this writer attended a jobbers' meeting, representative of three states, summoned for the express purpose of examining PDO 1, yet only one smuggled copy of the order was available for all present. Officials of the subcommittees even denied an NPN representative the chance to read the order.

Mr. Hochuli assumes that the Marketing Committee's three subcommittees are representative of the jobber and dealer levels of the industry and are able to express representatively the views of these levels. In light of past operation, this assumption is unrealistic.

Mr. Hochuli cited that only one of the subcommittees mustered a quorum on call for a meeting to discuss PDO 1. This, says Mr. Hochuli, expresses lack of interest. This writer later canvassed some of the members of those committees and received a different explanation. One said: "We don't attend when we should attend because we have felt PAW's whole gesture of seeking our advice was just pretense. We often don't receive notification in time to drop our business and

hurry here from Maine or Florida on a 24-hour notice. Even when we do get together there has been a sense of futility; we've felt that whatever we did, PAW already had made up its mind. Why shouldn't we have felt that way; we're only invited 'observers' at the Marketing Committee's sessions and we can't even talk until we're invited to do so."

If PAW would translate Mr. Hochuli's assumption of democratic industry representation into a reality, it must permit to flower in the jobbers' minds that sense of true participation in government-industry decisions, that feeling that the ideas with which these men wrestle do have some chance of registering on Washington officialdom. It is not to locate blame to report that feeling of confidence has largely not existed in the past, but to underscore it as a fact and all that such a situation means to the best functioning of our industrial society.

In this cause no more eloquent plea could have been made than John Scott made in that meeting to Mr. Hochuli himself:

"Mr. Hochuli, we have not dared you to come here and talk with us; we have wanted you here so that we might sit down and talk together. I ask you, Mr. Hochuli, if you wouldn't be ready to suspend this order until we all have a chance for its further study. I have struggled with these problems for the last two years, working on them five solid days a week. I can't believe that you want to throw confusion into what I and so many others have been doing."

In the face of such appeals as these, time is not the determining factor; more important is the democratic building of industry confidence. That, as Mr. Scott said, is PAW's responsibility to the jobber and the dealer.

Midwest— *Texas Long on Crude, Midwest Short—but Supply Is Dragging* —By Earl Lamm

CHICAGO—Effort to get more crude to Dist. 2 refiners is dragging, although the refiners need it badly and the producers in Texas say they have an ample supply. A number of refiners have requests for tank cars on file at the Dist. 2 PAW and industry offices, and assignments have been promised as soon as the cars become available. A magician with power to pick 20,000 new tank cars out of the air to ease the situation would be deserving of an essential status, according to one transportation man's estimate.

Mr. Lamm

Declining production in Dist. 2, plus the nearing completion of all 100-octane plants, with many of them coming on stream, adds greatly to the crude worries of refiners making other than war products. The crude oil supply panel held a two-day session last week instead of the usual one-day meeting, and finally came up with a supplicant list for April of only 29,250 b/d—about 17,000 b/d less than for March—indicating that the lesser amount was all the surplus crude available for sharing with refiners who are short. Refiners who can find anything like a permanent supply or partial supply, however, continue to make side deals, including exchange of products for crude.

A logical conclusion would seem to be that companies supplying crude under the present voluntary crude sharing plan will cease their offers as soon as other crude becomes available either from West Texas and Wyoming by tank car or from Louisiana by barge and tank car. DSC compensatory plan for movement by barge from Louisiana and tank car from Wyoming was still in the development stage at the end of last week, with definite approval momentarily expected. It is not anticipated now that DSC will go beyond that and approve compensation on shipments from other origins as was discussed some time ago. It is said that the stockpile of crude being accumulated on the Gulf Coast is being held there pending completion of the new war plants.

Another logical conclusion explaining the slow movement of West Texas crude to Dist. 2 refiners is that they do not want to use it unless they have to, and that they are holding off on the chance that DSC will approve compensation on sweet crudes from other sources. With Louisiana-Wyoming areas O.K'd by DSC and other origins out of the picture, the refiners can take it or leave it and cut their throughput. Under present regulations, PAW has no legal way to force refiners to use sour crude, it is said. But when tank cars become available and supplying companies quit sharing the sweet crude they have, it will be a powerful influence for the supplicant refiners to do something else. This influence is expected to start working in the very near future, with a material increase in the use of West Texas sour crude during this month. One plan suggested is that total runs by supplicant plants must include 10% sour crude before there will be any further sharing. To date the only compensatory movement of sour crude reported is 20,000 bbls. per month by Johnson Oil Supply at Gary, Ind., and Globe at Lamont, 5000 b/d with request for 1500 b/d more.

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PAW Plugs for Manpower

PAW of Dist. 2 has offered to help refiners head off a manpower grab of technicians under 26 engaged in production of 100-octane gasoline. Wire was sent all Dist. 2 refiners on Mar. 27 explaining the PAW-Selective Service setup whereby PAW is authorized to endorse special requests for deferment of key men.

A chemical company in Chicago manufacturing catalyst asked if two of their men could be deferred and were told to fill out the necessary forms and see if the men met the requirements. Since deferment applications go direct to the PAW labor counselor at Washington, and Selective Service, data are not available here on number of men affected, but refiners say unless deferments are granted they will be seriously hampered.

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Farm Tanks Now Available

Independent oil jobbers who have been objecting to revision of PAO 12, which now restricts the lending of tanks to farm accounts for the reason that the elimination of this restriction would favor major oil companies because the big companies "have warehouses full of idle storage tanks" can find solution of this situation in PAW Redistribution Program No. 2 (story on p. 48) of surplus tanks and other equipment.

This program requires participation of all operators of five or more bulk plants or 25 or more service stations, which means that the inventory of 4778 tanks now in the Dist. 2 PAW surplus materials pool are owned by large companies from whom jobbers may buy them by voluntarily joining the pool as prescribed by PAW regulations.

Fight Arkansas Hospital Levy Asking Heavy Oil Imposts

Special to NPN

LITTLE ROCK, Ark.—The Hollingsworth Hospital Act, prepared for submission at the Nov. 7 election, was opposed by Arkansas Public Expenditure Council at meeting in Hotel Marion here on Mar. 30. The council adopted a resolution vigorously opposing the measure, which would impose a heavy severance tax on natural resources of the state, including petroleum and natural gas, then add a chain store tax affecting bulk plants and service stations, starting at $50 for the first five stores and graduating to $400 for 50 stores.

The tax on crude oil would start at 6c a barrel for 22 gravity and run to 11c for 43 gravity; distillate tax would be 11c per bbl.; natural gasoline and casinghead, 1c per gal., with 3/10c on each 1000 cu. ft. of natural gas.

Letters From NPN Readers

Kenneth Walsh Again

FROM: Kenneth Walsh. TO: The Editor.

Do you remember the article (it really was a sermon) you read on NPN's cover of Jan. 12 that was written by a young American sailor in the South Pacific? Well, here's another letter from Kenneth Walsh that we thought you'd be interested in reading—The Editor.

I want to thank you for the interest that you have taken in my article. In writing my little opus, I never realized the repercussions that it might have caused. Since its inception in the newspapers, I have been commended and likewise cursed.

To those who commended the letter, I want to thank from the bottom of my heart —to those that cursed it, I would like to remind them that it is a war of Supply and not a war of Profit and Loss. Capital and Labor as far as the man at the front is concerned, is something in a dim forgotten past.

There is a Supply line out here of important dimensions that must be satisfied. Until that happens, ultimate victory will hang in the balance. I am in a position to see just what a floundering Supply line can do to a nation, and at this time I thank God that it is not ours.

Horse Sense Indicated

FROM: Elmer Lloyd, Stonewall Jackson Hotel, Clarksburg, W. Va. TO: The Editor.

Re your admonition to distributors to formulate desired changes in OPA and transmit their plans to their representatives—

May the writer point out that he feels that the changes necessary are basic in nature rather than administrative. Down in these hills if we want our horse to move in a northerly direction, we don't stand at the north end of the horse and beat him over the head. We go around to the south end and lay on the "bud". No, I'm not claiming that the oil men and auto owners are horses. I'm only supposin' that they have at least as much sense as a horse. So if OPA is to get its job done it's gotta move around to the other end of the horse. It's gotta take off its flannel lounging clothes and put its shoulder to the wheel and while it's a-pushin', if it'll just speak kindly to old Dobbin, it'll find the load a-movin' ahead.

In other words, don't make no difference what kinda rules Congress might make, as long as the disciples of Frankfurter, Hopkins, Cohen, etc., are executin' the rules; 'taint no use a-figgerin' on folks a-havin' any regard fer the rules, and if they haint no regard fer the rules, then they're all a-wastin' time.

How can a feller like me explain the coefficient of expansion of gasoline to a feller named Spiller, fresh outa some eastern law school, wearin' flannel pants and a checkered coat and his eyes and soul ponderin' on the thots of a "Frankfurter"? How can a feller like me argue with a feller named Solof also wearin' studio pants and blouse and worshippin' some far away idol, about why 2800 gal. gas coupons aint got no license number so's he can read, without me a-gettin' riled up and buckin' just a little?

Yes sir, Mr. Platt, if they don't move around to the proper end of the horse, us common American individualists aint a-goin to be in business. We're a-goin' to be in jail. We jest don't like a lot a outlanders tellin' us what we caint do.

Urges OPA Leniency

FROM: Edmund J. Cross, president, Refiners Tank Car Service Stations, Chicago. TO: OPA Chief Bowles.

I have just returned from the office of Mr. Nowlan, Chief Enforcement Officer, after having discussed with him my request that we be relieved in this instance from the instructions given our ration bank to debit our account 1694 gallons for failure to place license numbers on ration stamps.

Our position is representative of many other independent licensed distributors in this state, and what I say in this letter has application to them also. Most of them cannot afford to make personal appeals to your office in Washington and your Chicago offices state they have no authority to give relief in these cases.

We have been marketing gasoline for the past 14 years, and this is the first black mark received by us. We would not feel so badly about it were it not for the fact that we have attempted at all times to comply with your regulations and to instill in our customers that gasoline enforcement is necessary. However, when instructions were originally issued to place license numbers upon tickets we did so, but found later that our competitor across the street, a major company, was not doing so, and that as a result we were losing business to him. Violations of this particular regulation became generally prevalent until your department decided quite properly to insist upon its enforcement. However, those of us who were hurt originally by the failure of the large majority of distributors to make such endorsements did not feel that the larger part of our competitors would comply with your new order to refuse to accept as of Jan. 29, 1944 unendorsed coupons and therefore they were not so willing to comply therewith because of their mistrust of such competitors. Such was our case, although, instructions were given our employes to comply therewith.

I believe and hope your present plan of coupon endorsement will be successful eventually. However, it will take some time to make it completely so. During such period, it is our suggestion that your department should administer its enforcement program in a humane way, and where there is a first violation, as in our case, which is not wilful, rather than to incur the displeasure of the distributor, another opportunity be given him to make such compliance for to penalize a distributor who wants to go straight and avoid the black market to make good his shortage simply antagonizes him so that in the future it will be difficult, if not impossible, to procure his voluntary co-operation. Too much work has already been placed upon the man at the pump by persons connected with your department who are unfamiliar with the work that must be done by them and the conditions under which it must be done. He must not only act as your policeman but must in many instances accept rebuffs and insults from customers in doing so. Nor does he receive remuneration for this difficult work, for which banks are paid, yet he does so at the risk of losing business to his competitor who might not be so willing to act as your policeman.

There are unscrupulous dealers who in a case of this kind would choose to go into the black market and purchase tickets sufficient to make good their shortage. But the greater number of distributors would not choose to do this and would desire, as we, to throw ourselves upon your mercy and accept whatever leniency you might show us. It is for this reason, we make this request hoping that you will recall this debit and thereby inculcate a desire in us voluntarily to comply with your regulations, rather than by compulsion.

We hope that you will see the justice of our request, and it is our suggestion that your Chicago office be also invested with sufficient authority in this and similar cases to afford relief where warranted. I am sure that your treatment of us in this manner will effect a better cure than were you to insist upon penalizing us for this first offense.

Act Now on New OPA Law!

FROM: Clyde G. Morrill, secretary, Atlantic Coast Oil Assns. Conference: TO: The Editor:

I am enclosing copy of a letter written to the Hon. Joseph W. Martin, Jr., Minority Leader in the House. It is self-explanatory.

Now is the time for us to be agitating for changes in the Act that will enable OPA to stay in business. The present act expires on June 30. It seems to me that oilmen should be pressing their congressmen and senators for a fairer handling of enforcement of OPA regulations. Oilmen have enough difficulty in carrying out the multitudinous regulations of all the departments in Washington without being subjected to the petty persecution of being hauled into court by the OPA Enforcement Division on technical violation charges.

I know that Col. Houston is presently engaged in a very careful study of this matter. It will do no harm, however, to have pressure developing on the Hill.

FROM: Mr. Morrill. TO: Rep. Martin.

There follows a copy of a news report taken from Platt's Oilgram dated Feb 28:-

"BAR PROPOSES CURB ON OPA COURT POWERS"

"CHICAGO—Move to curb OPA and Kangaroo Courts" was made by the American Bar Assn. meeting at the Edgewater Beach Hotel here today. Group approved in general draft of a bill it proposes to offer Congress on regulation of governmental agencies. Bill contains, among other things a provision to stop OPA from acting as prosecutor, judge and jury, according to Joseph W. Henderson A.B.A. President.

"Proposed bill applies to all federal agencies except war agencies, Henderson said and contains four points—Insures defendants in complaint cases full hearing before determination of guilt or innocence by the agency; requires agencies to give respondent full particulars on violation charges with opportunity to answer; compels federal agencies to prepare records of specific findings in all hearings, provides a simple procedure for a complete review."

The so-called Kangaroo Court of OPA has been an extremely disturbing development in connection with enforcement policies on the part of OPA relative to the rationing of fuel oil and gasoline.

In recent months, due to energetic protests from this office and from other executives of oil associations, there has been increasing evidence that OPA was attempting to be more fair-minded in its enforcement than was the case initially. However, the setup remains the same, and regardless of policies laid down by superiors there is always in any given area a temptation for a local enforcement officer to be extremely arbitrary. The American Bar Assn. have recognized this, and their action is, I think, one in which we heartily concur.

It is my understanding that the Enabling Act giving OPA authority to prosecute for violations of its orders expires June 1. I do not know whether this is a power granted OPA through WPB, or whether it is a power given OPA directly by Congress. Perhaps you can determine this for me in order that we may be prepared to anticipate the expiration of the present act and act concertedly in an attempt to support legislation that might change OPA's method of enforcement.

The assumption on the part of war agencies of judicial acts that should properly remain in the hands of the courts has been an extremely disturbing development during the present Administration. I think you will agree with me that wherever a change can be made it should be attempted immediately.

Scientists Protest Army's Raid of Technical Men as Sabotaging of Industry's War Effort

WHILE THE NEWS REPORTS from Washington over the week-end seem to assure industry that its young and highly trained technical men will not be ruthlessly and ignorantly drafted from the Production Army to the Combat Army, to the extent of shutting down vital war munition plants, nevertheless the oil industry should not consider this continuing controversy with the War Department as won.

Even if the War Department, and the Navy Department as well, (although the Army seems to be the most obtuse and obstinate offender) stay put on their recent change of policy, it is a long road that an occupational deferment for a technical man must travel before final decision is made. Then that final decision is made by the local draft board which does not have to pay any attention whatever to the recommendations of the military authorities or the technical advisory committee that has just been set up, and the local draft board may be biased, ignorant, indifferent and incompetent.

Also by the time the local draft board may receive the recommendation of the new national technical committee, it may already have acted and put the man in the army. From that action there seems to be no appeal, the military authorities just waving their hands and saying that what is done cannot be undone.

At the moment the present drive to save highly trained technical men applies, in the oil industry, only to those in 100 octane aviation gasoline, butadiene and such direct war product refineries, though the oil industry, like other industries, has a vital story to tell about its other technical men whose services in the Production Army are necessary in producing the supplies that the Combat Army needs.

Industry Ignored as Usual

THE PRESENT DRIVE to keep technical men on the job where they are most needed comes as the result of an unexpected recommendation from President Roosevelt a week ago that all men under 26 years be drafted regardless of their jobs. This action was taken by Roosevelt, according to most reliable reports, just as he has taken so many other important actions, without consultation with other arms of government and the industries most concerned. Neither WPB nor PAW were consulted. They learned of the action from the newspapers. Even Gen. Hershey of Selective Service and Chairman McNutt of the War Manpower Commission are said to have been kept in the dark by Roosevelt. There are stories of other occasions when the War Department bulled its way past these two officials just as it has ignored WPB and other important war agencies. One cannot help but wonder, if the truth were known, whether the confusion and seeming gross mismanagement of the manpower situation cannot be laid directly to such arbitrary and inefficient interference by the War Department and a few people in the White House.

When this order to demoralize the Production Army became known the protest was loud and vehement with the result that a committee of interested war agencies and industries appointed itself to make recommendation as to specific technical men under 26 who should be deferred from the draft. But the committee can only recommend and Roosevelt and the War Department can issue more orders and recommendations without knowledge of the committee.

Business men at Washington, both in and outside of war agencies, are naturally loath to criticize the military forces, because these services can "gang up" on a critic and make life miserable for him. However that some well-informed men of conservative judgment believe that there is something fundamentally wrong high up in Washington, that even there seems to be a selfish and sinister influence at work, is indicated by a statement issued after Roosevelt's unexpected order against young technical men, by Dr. Charles L. Parsons, secretary of the American Chemical Society, now holding its 107th annual meeting in Cleveland this week.

Certainly no one ever accused this large, and influential organization of being precipitate or radical. Its membership includes the outstanding scientific brains and judgment of the country. Its requirements for membership are high; not every one can join it as one may a trade association.

A Well-Deserved Rebuke

DR. PARSONS, as secretary of this august society, has issued a truly stinging rebuke to the military authorities at Washington and any others involved in this sabotaging of war production. The statement was drawn up by a special committee of scientists, on which, among others, was M. T. Carpenter, associate director of research of the Standard Oil Co. of Indiana. The statement also was approved by representatives of 82 of the largest companies active in the general chemical field. So there is much weight of conservative scientific and industrial opinion behind this scientist's criticisms.

Says Dr. Parsons' statement, for the American Chemical Society:

"No one seems to know upon whose advice were issued the recent orders quite generally interpreted to mean the induction of all men under 22 years of age, later increased to 26 years. They appear to have been issued under an influence far more interested in filling a theoretical quota than in efficiency.

"Those who drew the picture are able to realize the necessity for such a small part as the trigger on a machine gun but have little conception of the necessity for the continued control and development by chemists, chemical engineers, physicists, and other scientists who make possible all modern war equipment for the Combat Army.

"The many new developments and weapons of war (practically all of the highly specialized war petroleum products for illustration. Editor NPN) which are saving the Allies from defeat have been developed and created by our scientists and engineers in intense competition with the scientists and engineers of Germany. The Production Army must not be retarded by those who apparently are quite incapable of understanding this basic necessity.

"In my opinion the remedy lies in mass deferment," said Dr. Parsons.

"The scientific men make up an almost negligible percentage of the eligible manpower under 26 years of age. Their deferment is an absolute requirement in England.

"In America at least 3000 chemists and chemical engineers are in the Army and Navy serving as though they

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

had received no scientific education and training whatever. (NPN knows that if PAW were to make a survey of specially trained oil men in the two services it would find a large number engaged in inconsequential and non-technical and non-oil jobs even though these military services are still making direct raids on the industry's badly needed personnel instead of appealing in an orderly manner through PAW. Editor NPN)

"We are informed that at a recent conference an Army officer stated that the War Department was gambling on a short war, although publicizing a long one." (Reports of this character have leaked out at different times so that it is the opinion of some oil men that the Administration decided to take its chance on a short war and a short crude oil supply, rather than back down from its face saving "hold-the-price-line" position and grant higher oil prices in an intelligent effort to get more oil in this country. Editor NPN)

Dr. Parsons, for himself and his brother scientists, undertakes to anticipate history's appraisal in observing that the war is being won by joint efforts and he observes:

"It is the Production Army more than the Combat Army to which history will largely award credit.

"The picture and the plan for victory are being drawn today in khaki, by unknown artists who appear to be blind to any other shade. . . . . .

"To ignore this fundamental fact (the importance of the technical man and the Production Army,) is to court disaster."

The war supplies from the oil industry's Production Army are so seriously threatened that Rubber Director Dewey, himself a scientist, flatly told the Army that it would have to decide between a few hundred highly trained young technical men to be added to the millions of its infantry and a drastic reduction in the Army's supply of rubber for trucks, tanks, planes, etc. PAW executives said the Army would also have to decide between a few hundred technical men amounting to about 3% of the refinery operating forces and 20% of the research men, and not only less rubber, but a whole lot less 100-Octane aviation gasoline, less special motor oils for heavy duty war machines, less wax for food containers, to say nothing of a general retarding, even halting, of much development work which will produce new products before even a "short war" is won, that will help the Combat Army to fight harder and to live better.

Steel and coal people also have protested the 26 years and under order and have confidently predicted that if the order stands there will be an immediate reduction in their output. The coal men estimate a reduction of at least 10% from present insufficient output of coal. Incidentally, there is much idle oil well drilling equipment in this country due to the Army's avariciousness for men and disregarding of supplies.

Army the Worst Offender

THIS IS ALREADY a long dissertation on the subject but at the moment there is hardly a more important question before oil and all industry and before the country than this one of manpower. What the New Dealers may be trying to do to the oil industry and free enterprise generally with the Arabian pipeline plans is but an incident compared to what the White House and the Army are now doing to the country's vast Army of Supply through a refusal to work with or even consult with industry.

The trouble seems to be largely with the Army. Of the Navy, one hears praise from those business men who have intimate contacts at Washington, at least praise in comparison with what they say of the Army. The reason seems to be that the Navy is such a highly technical and mechanical organization, that its officers are nearly all highly trained engineers. They make their own big floating arsenals of war, literally floating machine shops and factories and they have to maintain and repair them just like big factories and power plants that are on shore.

Consequently these engineering minds of the Navy have a far better understanding of industry technical men, and skilled labor than the great bulk of Army men. In fact, it is common knowledge that some high Army men knew so little about Army mechanical and tractor equipment that they ignorantly destroyed much of it in early war maneuvers, while the Quartermaster's Department, which is primarily a grocery and clothing store, was so ignorant of trucks and engines that civilian experts had to be called in, and finally all such equipment was transferred to the Ordnance Department which is a vast factory and machine shop where most everyone from the generals down has a wrench in his hands and pliers in his pocket.

The Army's oil procurement section was floundering deep in incompetency when it was rescued a year ago and finally turned over to an Army engineer and a group of oil technical and operating men, since which time petroleum products are not only procured efficiently but, under the pressure of this same department, they are being used by the Army with some regard for their value and scarcity.

Supply Job Belongs to Industry

THE CONSTANT REFUSAL—or inability—of the Army to work with industry brings up again the question if modern war should not be looked upon more as an industrial, manufacturing and supply problem and less of a "squads right, and hep, hep march" proposition. Handling troops in combat is far different from planning and devising their highly complicated equipment and getting that equipment to them with all necessary supplies and keeping that equipment in fighting order. This question was fought over at the start of the war and on many occasions since, when Donald Nelson contended for WPB that supply is an industry job while fighting the troops belongs to those trained only to fight. But Mr. Nelson generally lost his arguments with the present demoralized manpower situation as one of the results.

Congress could well survey the situation to see if, despite the protests of the Army men and their two lawyer heads who never had any manufacturing or industrial experience, (nor have the "assistant presidents" over in the White House) there should not be a sharp line drawn between the Production Army and the Combat Army, and munitions production and transportation be turned over to men who have been trained in it and who understand it.

The record of the oil industry under PAW proves that industry can best manage industry problems. Oil, under PAW, has been successful in its war effort to the extent that it has been left alone by other war agencies and particularly by the White House and the Armed Forces. Whenever those agencies have imposed their judgment against the judgment of the oil industry, the oil industry's war effort invariably has been hampered. The best illustration of that is the present oil shortage. If the problem of oil supply had been left entirely to the oil industry, it is practically a certainty we would not today be suffering an acute oil shortage.

NPN submits that the above recital of facts should cause every oil executive to be constantly on the alert and on the aggressive to do everything in his power to see that his war effort is not sabotaged by ignorant and incompetent and inefficient divergence of his skilled and technical men. Appeal to your nearest PAW office for advice and help.

Smoother

from a trickle to full flow

Sure you want a hose nozzle valve that's rugged, light weight and easy to handle . . . but you want faster delivery with smoother control, too! Buckeye's famous Fig. 800 gives you everything . . . positive, effortless control from a mere trickle to full delivery (*Reason: Cam Action*) . . . freer flow without turbulence (*Reason: Streamlined Inside*) . . . smoother closing (*Reason: Cushioning Washer under Valve Disc*)—and when used with Fig. 802 curved rigid tube, blowbacks are practically eliminated! Write for Catalog No. 11.

Throughout America Buckeye's famous Fig. 800 speeds fueling of thousands of war workers' cars

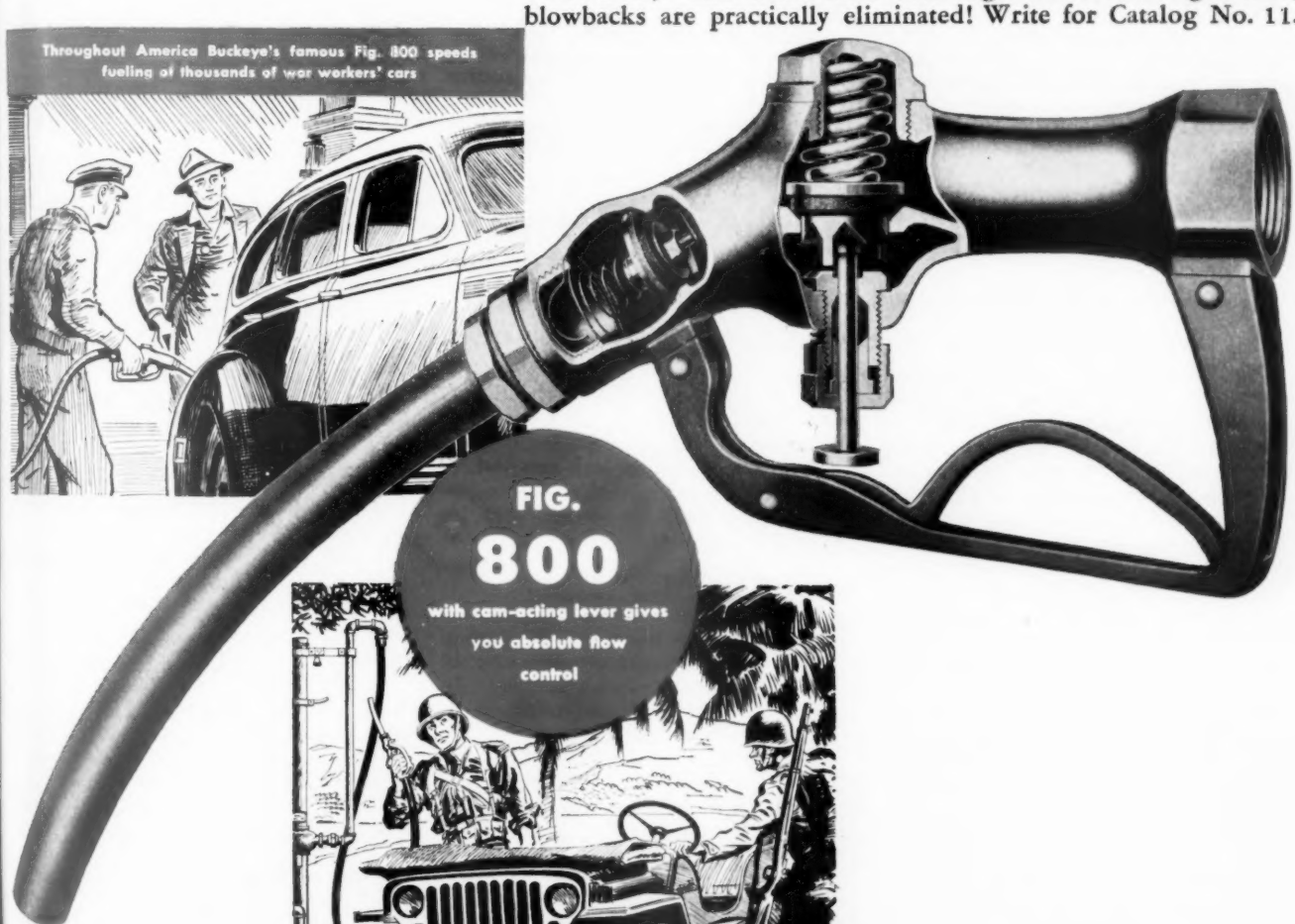

FIG. 800 with cam-acting lever gives you absolute flow control

And at field stations on every front Fig. 800 keeps trucks, tanks and jeeps moving for Victory

Buckeye provides a complete line of valves and fittings for service stations, airfields and bulk plants. Let us help you plan for the present . . . or for the future, simply write

BUCKEYE IRON & BRASS WORKS
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DAYTON

Quality Valves and Fittings
for the Oil Industry

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Some of the officers and speakers for the annual convention of the Tennessee Oil Men's Assn., in Nashville, March 26-28 are shown here, left to right: G. B. Dickey, Nashville, former vice president of the association; A. W. Roth, chief, manpower section, PAW, Washington; H. W. Nankervis, chief of facilities section, marketing division, PAW, Chicago; H. L. Thatcher, Chattanooga, president; Warren C. Platt, editor, National Petroleum News; W. W. Vandeveer, PAW Dist. 2 Director; Phil Rosenfield, Nashville, secretary-treasurer; Ernest L. Hughes, Dist. 2 Director of Marketing; P. D. Denton, assistant to Director Vandeveer

Tennessee Assn. Blasts at Arabian Pipeline; Asks 'Gas' Boost

P.I.W.C. Oil Policy Praised at Record Meeting in Nashville; Diversion of Highway Funds Condemned; Officers Re-elected

By Staff Special

NASHVILLE, Tenn.—About the largest annual meeting in the history of the Tennessee Oil Men's Assn. was that held at Nashville, Tenn., March 26-28. More than one hundred were in attendance at all general sessions.

C. L. DeBord, Johnson City, was added to the board of directors and all other officers were re-elected as follows:

H. L. Thatcher, Chattanooga, president; Julian Allenbery, Memphis, second vice president; Phil Rosenfield, Nashville, secretary-treasurer; Alfred T. Levine, Nashville, general counsel; R. S. Kennedy, Knoxville, L. D. Stapleton, Athens, J. F. Cummins, Nashville, Horace Allen, Murfreesboro, Lee Brasfield, Dresden, and Louis Draughon, Springfield, directors.

The Association adopted resolutions condemning the proposed Arabian pipe line and approving the foreign policy as promulgated by the Petroleum Industry War Council. In other resolutions the association—

Demanded OPA authorize a ½c a gal. increase in the retail price of gasoline to cover added costs of operations and rationing details;

Charged that Tennessee has taken the lead among southern states in diverting highway revenue to non-highway purposes and advocated adoption of a constitutional amendment to prohibit the practice;

Requested that if premium is to be discontinued or civilian volume reduced that price margin be adjusted on regular to compensate for the loss in revenue;

Petitioned PAW that the proposed PAO 1 shall not be made to apply in any area "where a historical basis is used to determine the supply at the original supplier level and that in such areas where a historical basis is used a similar historical plan shall be put in effect for secondary suppliers."

Levine Arranges Program

General Counsel Levine of Nashville, had arranged a full program starting with a buffet supper Sunday evening and concluding with lunch Tuesday. In connection with the convention, there was a meeting of the Tennessee Petroleum Industries Committee of which F. W. Butler, Standard Oil Co. of Memphis is chairman, and Lew W. Collins of Nashville, secretary. That was held Tuesday morning.

J. F. Cummins, of the Cumberland Oil Co., Nashville, at the opening session, introduced the representatives of the supply companies who had contributed to the association's treasury and are taking space in an annual directory.

President Thatcher presided at all sessions. Governor Prentice Cooper of Tennessee, welcomed the oil men and told how he almost became an oil man. The oil field at Smith Mills, Tenn., came right up to the line fence of his family farm. He lamented at the preciseness of this geological occurrence because on his side of the line fence there were nothing but dry holes drilled. He said that while the oil men might not always agree with the state's using some of the gasoline tax money for expenses, nevertheless the state was duly appreciative of the importance of the industry and the cooperation of the oil men. He is viewing with some uneasiness the ending of the Army maneuvers in the Tennessee area which in taking a large number of troops elsewhere, is also removing a large number of gasoline customers, which affects the state's revenue. He said the 860 miles of roads in the maneuver area are left in bad shape and it is going to take a great deal of money to repair them.

Mayor Thomas L. Cummings of Nashville, handed over the keys with the injunction to be careful and please return them.

What Are Government's Plans?

A talk by Warren C. Platt, Editor of NATIONAL PETROLEUM NEWS, closed the morning session. He was asked many questions as to the proposed Arabian pipeline deal, including what did he think the association should do. Mr. Platt had pointed out that in the large investment in pipelines, trucks, tankers, in the Canol project in Canada, in the proposed new refinery at Mexico City, and the proposed drilling campaign at Point Barrow, Alaska by the Navy, there is sufficient warrant for oil men asking the question as to what the government intends to do about the oil industry. Does it intend to enter it or not? The proposed Arabian pipeline, which he said would not produce a single barrel of oil or add to the supply of oil which had already been taken care of by American companies, could be a source of supply wich could put into operation for the government all of these government-owned facilities, if the government saw fit.

The manpower situation was discussed by A. W. Roth, chief of the manpower section, PAW, at Washington, and him-

self an oil jobber and former president of the Indiana Independent Petroleum Assn., and Harry W. Nankervis, chief of facilities section, marketing division, PAW, at Chicago, and also an oil jobber from Wisconsin. Both men emphasized the detailed routine that a marketing man must follow in getting his key essential men declared "locally needed". They said that unless a jobber's man were so declared, it would be hopless for him to expect any occupational deferment from the draft.

Mr. Nankervis warned that while an oil jobber might be getting along all right today, most of them are right down to their last man and cannot afford to lose any more. He recalled being at a meeting recently with a War Manpower Commission representative who was telling a patriotic story and saying that he was not buying a new suit of clothes because he preferred to go in his old and shabby ones rather than use any more manpower, and he wanted to know how many jobbers had suffered real hardships through lack of manpower up to that moment. Three jobbers raised their hands, whereupon Mr. Nankervis said that he protested that the analogy of the suit of clothes was not a fair statement of the oil jobbers' situation because these jobbers are down to their last suit of clothes and when they wear out, they won't have any, and he illustrated it by asking how many jobbers could not afford to lose one more man; would the loss of one more man materially hamper their service to their essential customers, and he said every jobber in the room raised his hand.

Make Surveys at Once

Both Mr. Roth and Mr. Nankervis urged the jobbers to make their surveys at once under the "locally needed" rule. Jobbers are to write in to PAW's District Office, Manpower Division, which will give them the necessary forms for getting a petition signed to start a request to have an area declared "locally needed". Oil men were urged to make haste today because the industry's distribution service to the essential users of petroleum products will be materially hampered, it is feared certain, unless there is recognition by the War Manpower Commission and Selective Service, of the essentiality of oil distribution.

Ernest L. Hughes, director of marketing, Dist. 2, PAW, at Chicago, said that he thought the jobbers' position in the industry was stronger than ever both economically and politically and that he knew from his own contacts with major oil company executives, that their thinking was turning more and more in the jobbers' direction and recognizing that jobber distribution is more efficient when properly carried out. Mr. Hughes said that he knows some people hold the hope that when the war crisis is over, there still may be directives from PAW and other war agencies which will seek to prevent bad marketing practices. Mr. Hughes wanted to assure his hearers that so far as he and the present staff of PAW at Chicago are concerned, they will oppose any such directives.

As to the ambiguity of some orders, Mr. Hughes said he and his associates at Chicago were taking the position that if an order needed a long-winded interpretation, then they were insisting that the order had to be rewritten. Any order, he said, that didn't say plainly what it really meant, was not a good order. If interpretations were permitted, then there would soon be interpretations of interpretations and nobody would know what the order really was aimed at.

PAW Director Vandeveer of District 2, Chicago, read a formal talk and then answered questions. Excerpts of the formal statement are:

"This is known as an oil war. As a matter of fact, more than fifty per cent of all offshore tonnage is petroleum. The tremendous requirements of the Navy, supply ships, and our Allies boost that figure.

"The air forces use more high octane gasoline than the entire motor fuel consumption of the armed forces on the ground, or the entire fuel consumption of the Navy afloat. It takes 12,500 gallons of gasoline to train one pilot. This is the equivalent of 4,125 "A" coupons at their present redemption value. Reduced to a mileage basis, this quantity of gasoline represents 187,500 miles at the rate of 15 miles per gallon, which is more than many motorists use in a lifetime of normal driving. Our fliers must be trained.

"To keep in the air for just one hour the Navy's fast new fighter plane—the HELLCAT—requires as much gasoline as it would take to drive a car from Nashville to Miami, Florida and return.

"The petroleum industry can take satisfaction in the fact that this military demand—colossal in size—has been met. . . . "

Demands Constantly Rising

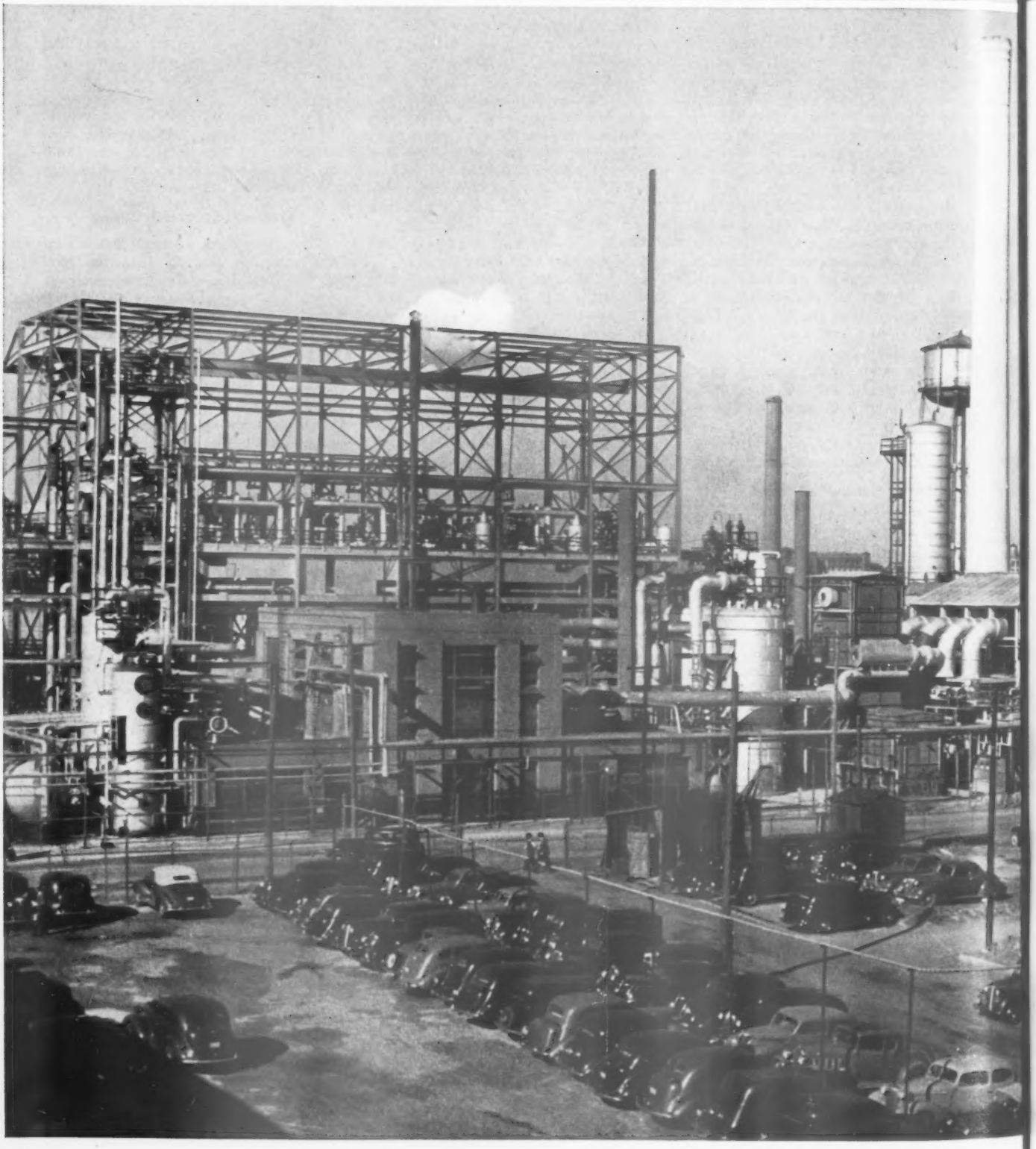
"The Petroleum Administration for War estimates that in 1944 the total for both civilian and military requirements, are approximately 1,800,000,000 barrels of petroleum liquids. This represents an eight per cent increase over the petroleum requirements of 1943 with an increase of 27 per cent over the requirements in the United States during 1939.

"Although known underground reserves of some 20 billion barrels are equivalent to slightly more than 11 years' consumption, based upon estimated requirements for 1944, it would not be physically possible to produce that reserve in 11 years' time. Actually, some of the oil included in this total will not be recovered in even 50 years from now. . ."

"Just last week, the Petroleum Administration for War announced the allo-

Snapped in attendance at the annual meeting of the Tennessee Oil Men's Assn. at Nashville, Tenn., March 26-28 was this group, left to right: Lew W. Collins, secretary of the Tennessee Petroleum Industries Committee; B. C. Clouse, Nashville; H. B. Carter, Cleveland, Tenn.; and D. W. Chase Jr., Cleveland, Tenn.

Seven years old and



d raised on bottoms!

Sun's 11-4 Houdry unit has cracked everything from refinery slop to light gas oil

An excellent demonstration of the flexibility of Houdry fixed-bed units is provided by the oldest of them all—the Sun Oil Company's 11-4 plant at Marcus Hook, Pennsylvania, which went on stream in April, 1937.

With a capacity of more than 10,000 B/D of oil to the catalyst, this was the first large-scale Houdry unit ever built to run bottoms.

From 1938 to 1941, it operated steadily on refinery residue—the 35% bottoms of all crudes processed—producing gasoline of about 90 octane (CFR research). Then, during the first year of war, it was converted to aviation fuel production, so desperately needed by our armed forces.

In 1943, this Old Faithful of catalytic cracking was still further improved, to provide even greater production of catalytic aviation base stock, a vital war assignment which it continues to fulfill with great distinction and dependability.

The ability to handle both light and heavy charging stocks is one of the outstanding advantages of Houdry Catalytic Processes. These processes and the T.C.C. Process are available to any and all American refiners, under license arrangements, subject to approval of the United States Government.

Houdry PROCESS CORPORATION
WILMINGTON, DELAWARE

LICENSING AGENTS: E. B. BADGER & SONS CO. Boston, Massachusetts • BECHTEL-McCONE-PARSONS CORP. Los Angeles, California • THE LUMMUS COMPANY New York City, New York

HOUDRY CATALYTIC PROCESSES ... FOR VICTORY IN WAR ... FOR PROGRESS IN PEACE

Louis Draughon, Springfield, Tenn., a director of the Tennessee Oil Men's Assn.; W. G. Owen, Nashville, J. P. Burns, Nashville, and Elmer H. Schramm, Cleveland, O., are shown here, left to right, during the association's annual meeting in Nashville, Tenn., March 26-28

cation of 1,250,000 barrels a day of automotive gasoline for civilian consumption during the second quarter of 1944. This amount represents an increase of 140,000 barrels daily over the first quarter allocations. This increase of 140,000 barrels per day over the first quarter allocations does not mean that there will be more gasoline for motorists. The upward adjustment was necessary to meet seasonal requirements of farmers, truckers, and construction companies. Naturally, it is impossible to supply civilians with all the gasoline they want, and it will be as long as the enormous military demands continue.

"It has required a tremendous amount of planning and work to make available the quantities of motor fuel for essential civilian requirements and to keep these supplies flowing uninterruptedly to suppliers on an equitable basis. . . ."

The questions put to Mr. Vandeveer were varied and brought responses that in substance are that the military demand for petroleum products has been increasing steadily and even unexpectedly, and that it probably will continue to increase. Recent heavy orders for Diesel engine fuel, he said, are undoubtedly called for by the fact that there are more than 80,000 Diesel engine and gasoline engine-powered small boats, landing barges, and so on, in operation today. His authority for that statement he said was a story in a current national weekly, but he said he could well believe that the figure is accurate. He told about the recent arrangement with RFC for compensatory freight rate payments for crude shipped into Dist. 2 refineries from all points, not only West Texas, but Wyoming. However, he said the use of West Texas sour crude could fill only a fourth or so of the 220,000 barrels a day idle refinery capacity of Dist. 2.

Speaking at the Tuesday session were:

Marvin Hall, District Mileage Rationing representative of OPA at Nashville, subject "OPA and Rationing".

George F. McCanless, Commerce, Finance and Taxation Department, State of Tennessee, on "Effective Reduced Gasoline Tax Receipts on State Revenue". Declining revenue, he said, is facing the State with some very serious operating problems, the answers to which were not yet apparent.

W. E. Eberts, Sales Manager, Pharis Tire & Rubber Co., subject "Our Synthetic Headache".

Lieut. R. D. Hyde, Procurement Officer, 20th Ferrying Group, who talked on "Gasoline and Its Relation to the Ferrying Division of the Air Transport Command".

Lieut. R. N. Strafford, Jr., bomber pilot, who told of his experiences in the South Pacific war theatre.

Set I.P.A.A. Meeting Date

Special to NPN

BRADFORD, Pa. — The mid-year meeting of the board of directors of the Independent Petroleum Assn. of America will be held here April 27-29, according to Ralph Zook, I.P.A.A. president. At the same time, a joint meeting of the directors of I.P.A.A. and the National Stripper Well Assn. will be held. J. D. Sandifer, Jr., Breckenridge, Tex., heads the stripper well group.

Field practices in secondary recovery will receive emphasis at the meeting, Mr. Zook said. A tour of engineering and core analysis laboratories in the Pennsylvania area to see tests made on sand, to determine its susceptibility to water flooding is also planned.

Postwar Planning to Keynote Natural Gasoline Parley

Special to NPN

DALLAS — Natural gasoline's postwar outlook will be one of the principal topics for discussion at the War Products and Postwar Planning conference of the National Gasoline Assn. of America, to be held April 12-14 at the Hotel Baker in Dallas.

D. P. Barnard, associate director of research for Standard Oil Co. of Indiana, will present a paper on the "Relation of Catalytic Cracking to Natural Gasoline Operations—Postwar", covering possible postwar fuel requirements, economics, and supply and demand as influenced by modern war-erected refining plants.

James E. Pew, director of PAW's Natural Gas and Natural Gasoline Division, will discuss "The Future of Liquefied Petroleum Gases". His paper will present a symposium of the opinions of leading gas and oil companies regarding the supply of these products during the balance of the war, in the immediate postwar period, and for three to four years of peace-time developments.

N.G.A.A. President James W. Vaiden, vice president of the Skelly Oil Co., will present his report at the opening session, Wednesday morning, April 12.

Closing day of the conference will be devoted to an "Information Please" session, presided over by D. E. Buchanan, president of Hanlon-Buchanan, Inc., Tulsa. During this forum, executives and technical men in the audience will be given an opportunity to question a panel of a dozen or so experts on processing, production and operating trends. Questions are to be submitted in writing to William F. Lowe, N.G.A.A. secretary, before the session starts.

Why I sell Cities Service Products

"Because I can order *a complete line* from *one* source . . .

"Cities Service Oil Company offers me a complete line of petroleum products and exclusive services for the motorist, farmer, and industrial consumer who are my customers and *potential* customers.

"I can purchase from this Company every item I need for the successful operation of my business which will give me more time to devote to serving my customers in the way *I* would like to be served.

"This community is my home, and I expect to make it my home for a good many years to come. I want my customers to be my friends, and this method of ordering one line from one source enables me to find just that much more time to make friends . . . and to enjoy them."

Popular Cities Service Products and Services for the motorist:

ACME BATTERIES	KOOLMOTOR GASOLENE
ACME TIRES	KOOLMOTOR MOTOR OIL
CISCO PEP	POWER PROVER MOTOR READING
CISCO SOLVENT	RIDE PROVER SEALED LUBRICATION
CITIES SERVICE MOTOR OIL	TROJAN GREASE

Texas WLB Makes Rulings in Four Oil Wage Disputes

Special to NPN

AUSTIN, Tex. — Directive orders handed down by the Eighth Regional War Labor Board affected four Texas oil companies.

In a dispute between the Oil Workers International Union (C.I.O.) and The Texas Co., affecting plants at Port Arthur and Port Neches, and the Pure Oil Co., affecting its Port Neches plant, the board denied the union proposal for a wage adjustment and change of classification for painters and insulators.

A wage dispute between the Columbian Carbon Co. of Pampa and the Oil Workers International Union involving 195 workers, was referred back to the parties for further negotiation. The board directed the parties to bargain collectively and report the results within 30 days.

A triparte panel, which held a hearing on the dispute, had recommended a general 3-cent-an-hour increase—excepting janitors and common laborers—compared with the union's proposal for a general increase of 10 cents an hour.

With no contract agreed upon between the Rudco Oil & Gas Co. of Tyler and Local 209 of the Oil Workers International Union, the board declined to take action on their dispute case and ordered the parties to bargain collectively and to report the results after 15 days.

100-Octane Plant Gets Tests

NPN News Bureau

TULSA — Units are now being tested and operation will begin "in the near future" at the new 100-octane plant of Associated Refineries, Inc., at Duncan, Okla., according to M. L. Freese, president. Extensions and additions have been added to the plant since the original plans were made, and plant will cost "in the neighborhood of $15,000,000", he added.

Takes Asphalt Institute Post

NPN News Bureau

LOS ANGELES—Harold R. Pauley of Petrol Corp. has been elected chairman of the managing committee of the West Coast division of the Asphalt Institute.

No Relief in Sight in Long Pull to Bring in Crude, Western Refiners Are Warned by Vandeveer

Special to NPN

ST. LOUIS — Dist. 2 refiners must utilize more West Texas crude, to be moved by tank car and probably water transport as well, in order to overcome serious shortage of products caused by idle refining capacity in the district, PAW Dist. 2 Director Vandeveer told approximately 200 refinery executives at Western Petroleum Refiners Assn. convention March 28.

Compensation for extraordinary transportation expenses involved has been approved by DSC for tankcar movement of West Texas crude to Midwest refineries, he said, stating a similar rate on movement of other than West Texas crude into Dist. 2 was now under consideration.

Mr. Vandeveer pointed out it would be some time before all stocks of crude now accumulated above ground in Texas could be absorbed by 100-octane capacity coming on stream and still under construction. Operation of the Little Big Inch products line shortly will free some tank cars now in eastern service, he said, concluding: "It is reasonable to believe that many of these cars will be put into crude service under the compensatory plan for the refiners of Dist. 2."

Touching on marketing problems, he said that the new PAO-1, now being discussed with industry marketing committees in all districts, when it becomes effective, will permit suppliers to prorate on equality basis by trade areas.

No Easing of Supply

"There is no reason to believe the supply position in Dist. 2 in general will become easier, since demands for war products are increasing, he said. "Production of crude within this district is declining and sources outside have not been developed to a point which will offset this decline.

"The trend in all branches of the petroleum industry today can be summed up in one statement: 'To do more and to make more with less manpower, yet maintain the vigorous characteristics of individual initiative and free enterprise'."

Assistant Deputy PAW Brown told refiners that, while 100-octane production within the next 60 days will be one-third greater than in March, 1944, the construction program is only 75% complete. Even then output will not be large enough, although production will be double the rate asked by the War Department soon after the outbreak of World War II.

"We will need all the plants being built, definitely," he asserted. This has been made possible, he continued, at a private investment cost of $550,000,000 in 100-octane plants built and owned by the industry since war began. Government owned plants to supplement industry's contribution will cost about $200,000,000.

As soon as possible, Mr. Brown said, the quality of 100-octane gasoline will have to be improved, so that performance will meet more nearly the aims of the air forces. Continued research and field performance data have vastly changed conception of what constitutes the best aviation fuel for today's engines, with indications now pointing toward an increased quantity of alkylate in the blend. Codimer will continue to be an essential blending component for some time to come, which answers industry's question on the disposal of such plants, because codimer happens to be the most successful substitute for alkylate.

A question of growing seriousness, Mr. Brown said, is the increasing loss of potential capacity through increased down time. Partly, the increased down time is a reflection of the manpower question, and already some plants have had difficulty marshalling maintenance crews and were delayed in getting on stream. Bad part of it is, he continued, that we may expect a 5% loss in total production of all products if this trend continues.

Suggests Two Remedies

As a cure, the speaker suggested two plans, one for war products plants and the other for the balance of the industry. "War plants" should make arrangements with the contractors who built the plant to provide a "flying squad" of experts in maintenance and repair. These would be available in an area and, by scheduling cleanouts and repairs on a regular basis, keep all the plants in good condition. This scheme is being used by some plants in California and the Gulf Coast now.

Other refiners should make arrangements among themselves to schedule their regular clean-out times, and borrow some of each other's maintenance and repair crews to augment their own. There are very few "isolated" refineries, to make the plan complicated or unworkable, he asserted, "although it may be a lot of trouble at first."

Another problem facing PAW, he said, is the increasing production of premium grade gasoline, despite PAW order reducing octane rating to 76 in order to save tetraethyl lead stock pile for high octane gasoline. Production of premium grade in January this year was much higher than it was in the fall of 1943 when the reduced octane rating was issued, and February production is expected to show the same trend, he said, with figures corrected to exclude all-purpose premium.

Mr. Brown explained PAW's plan for deferment of needed workers under 26, giving in detail the explanation already issued by the agency (*NPN, March 29, p. 3*). Seriousness of the problem is not easily seen at once on basis of statistics, he explained, because workers under 26 approximate only 3% of the industry's payrolls. But, of engineers and chem-

The team that never lost a game

A few years ago we cheered the winning football teams; yelled ourselves hoarse at gridiron heroes emerging victors in an uphill struggle.

Now we cheer another team—an all-American team—winning battles for human liberty—for us all, for our children and our children's children.

On the battlefield, as on the gridiron, teams win because they fight as teams—with teamwork—pulling together, fighting together, dying together. Unity spells victory.

There was the team of Colin Kelly and Meyer Levin. There are others like it everywhere — on land and sea and in the air. Boys of different faiths — Catholics, Protestants and Jews — native and foreign born; white and black, fighting together, dying together. Winning, because they stood together as Americans.

That's America. Teamwork like that made it. Teamwork like that will preserve it.

Enemy snipers are trying to break up our teams. They use their secret weapon — prejudice. They try to turn us against one another with hate and bigotries.

But we Americans know too well what makes winning teams. And we're going to keep on fighting together—all-American—until we're free to play together once again.

STANDARD OF CALIFORNIA

Quality-Service STANDARD

ARMY NAVY

E flag, with 2 stars, awarded to our Richmond Refinery

C. L. Henderson Again Heads Western Refiners

Special to NPN

ST. LOUIS — C. L. Henderson, Wichita, Vickers Petroleum Co., was re-elected president of the Western Petroleum Refiners Assn. at its 32nd Annual Meeting here March 28. He is serving his fourth term. Vacancies on the old board of directors were filled by R. L. Tollett, Big Spring, Texas, Cosden Petroleum Co.; F. H. Dunn, Tulsa, Wilcox Oil & Gas Co., and J. W. Vaiden, Tulsa, Skelly Oil Co. Balance of the board was re-elected.

The new board, in turn, elected R. W. McDowell, Tulsa, Mid-Continent Petroleum Corp.; T. M. Martin, El Dorado, Ark., Lion Oil Refining Co.; Mr. Tollett, and H. E. Zoller, Wichita, Derby Oil Co. as vice-presidents. John C. Day was re-elected secretary, and Mary Sue Collins treasurer.

Board of directors includes in addition to the new directors: Messrs. Henderson, Martin, McDowell, Zoller, H. T. Ashton, St. Louis, Socony Vacuum Oil Co. (Lubrite); Paul G. Blazer, Ashland, Ky., Ashland Oil & Refining Co.; Reid Brazel, Alma, Mich., Leonard Refineries, Inc.; H. W. Camp, Bartlesville, Okla., Cities Service Oil Co.; Sheldon Clark, Chicago, Sinclair Refining Co.; O. L. Cordell, Tulsa, Bareco Oil Co.; A. M. Hughes, Bartlesville, Phillips Petroleum Co.; R. R. Irwin, Kansas City, Socony-Vacuum (White Eagle); R. E. Luton, Robinson, Ill., Ohio Oil Co.; F. L. Martin, Tulsa, Sunray Oil Co.; W. E. Moody, Cushing, Okla., Deep Rock Oil Corp.; I. A. O'Shaughnessy, St. Paul, Globe Oil & Refining Co.; L. H. Prichard, Oklahoma City, Anderson-Prichard Oil Corp.; W. F. Sims, Wichita Falls, Tex., Panhandle Refining Co.; J. W. Warner, Tulsa, Tidewater Associated Oil Co.; C. B. Watson, Chicago, Pure Oil Co.; J. A. Welch, Shreveport, Arkansas Fuel Oil Co., and Rex H. Winget, Cushing, Cushing Refining and Gasoline Co.

C. M. Boggs, Arkansas City, Kans., Kanotex Refining Co. and L. B. Simmons, Duncan, Okla., Rock Island Refining Co., are ex-officio directors.

ists employed, about 20% would be lost to the armed forces, and it was on this basis that PAW interceded with Selective Service.

Commander P. H. Winston of SSS reviewed the general problems facing selective service that were the direct cause of the present "tough" policy.

Paul Ryan Speaks

The smaller refineries have one advantage over integrated unitsflexibility of operations—Paul Ryan of Cleveland told the afternoon session. The smaller units should pursue this advantage to the utmost, he declared. With the possibility existing that within a short time after hostilities slacken, there will be large supplies of motor gasoline created by wartime cracking capacity, the place for the average refiner to concentrate is on specialty products, he stated. "Such specialties, solvents for example, as will be in demand will sell for a good profit," he said. "While the specialties market may not be large in barrels, it will be great in dollars." Mr. Ryan spoke on "Petroleum in the Postwar Period".

Discussing the proposed Saudi Arabian pipeline, Mr. Ryan said it was uneconomic in transportation, unproductive of "one single drop of oil" and indicative of a government policy trend very dangerous to American refining industry. Moving the oil from Saudi Arabia to the Mediterranean by pipeline, and there refining it, would help Europe's oil picture but would not give the U. S. one more drop of oil than it now can get by tanker transportation, he said.

Fayette B. Dow of the Office of Defense Transportation's petroleum and other liquid transport division told refiners: "We are not out of the woods on transportation. Total products moving to the East Coast last week were about 1,790,000 b/d, yet there was a draft on stocks".

Despite Big Inch, Little Big Inch, barges and tank cars, if tankers continue to be uncertain then "the tank car burden may continue very heavy for an indefinite period", he concluded.

He introduced A. V. Borque of his tank car service section to discuss details of tank car situation. Mr. Borque said his intention was to spike rumored accumulation of idle tank cars.

"There has never been any surplus of tank cars over any real period of time," he said, as ODT has immediately apportioned them somewhere else where they were badly needed. The tank car situation changes daily, and sometimes several times a day, he continued, and as a result tank cars hauling gasoline today may be switched tomorrow to blackstrap molasses or chemical service, depending on urgency of need as certified to ODT by PAW, the Army, the Navy, and WPB.

He reiterated the statement: "We have no tank cars today, anywhere, to take care of all the needs for tank car movements. This includes oil, as well as all other products."

New Record Set By Crude Runs; Jan. Output 4,296,000 b/d

NPN News Bureau

WASHINGTON—Two new records were set in January when crude runs to stills reached 4,296,000 b/d and daily average domestic crude demand hit a new peak of 4,417,000 b/d, Bureau of Mines reported March 29.

While production increased 20,000 b/d over December and 590,000 b/d, or almost 16%, over January a year ago, it was still about 75,000 b/d below the record established in November when production totalled about 4,455,000 b/d. Most important crude production change during January was in California where output rose to 812,800 b/d.

Total motor fuel demand during January was about 35% greater than in January 1943 while gasoline yield from crude rose to 38.6%, about 2.1% over that of January 1943. Finished gasoline stocks increased 5,526,000 bbls. during the month to a total of 70,490,000 bbl. on Jan. 31, but were about 8,000,000 bbl. below the same date a year ago.

"In view of the rapidly expanding war demands for motor fuel," the bureau remarked, "total demands in 1944 may well exceed all previous records."

Record Forecast for 1944

To meet the new crude demand record of 4,417,200 b/d during January, stocks of domestic origin were cut down at the rate of 37,600 b/d. Total domestic and foreign crude stocks stood at 248,097,000 bbl. on Jan. 31 compared with the revised figure of 249,404,000 bbl. for Dec. 31.

Well completions dropped to 884 in January from 922 December, but were 201 above January 1943. Total initial production of new wells again dropped—from 183,800 bbl. in December to 163,000 bbl. in January.

Price index for crude and products was, according to Bureau of Labor statistics, 63.5 compared with 63.5 for December and 60.8 for January 1943.

Gulf Coast Crude Runs Gain, But Gasoline Stocks Decline

Special to NPN

HOUSTON, Tex. — Crude runs to stills in the first half of March continued on the upgrade while stocks of gasoline declined, according to a report by Gulf Coast Refiners Assn.

The crude run in the first half of the month was 11,656 b/d, an increase of 35,000 bbls. compared with the same period last year.

Gasoline stocks of 1,454,346 bbls. on March 15 represented a decline of 81,127 bbls. from March 1. The March 15 figure represents 50% of storage that is considered a normal inventory by the group.

Kerosine stocks decreased slightly from 160,223 bbls. to 141,342 bbls. in the first half of the month while Diesel gas oil stocks decreased about 8000 bbls. to 70,583 bbls.

Gas oil stocks of 1,031,446 bbls. was an increase of 178,738 bbls., No. 5 fuel oil increased 109,835 bbls. to 442,421 bbls. and Bunker C fuel oil increased 30,780 bbls. to 441,802 bbls.

Total stocks of all oils produced in the refineries comprising the association was reported at 3,721,465 bbls. compared with total stocks of 4,689,461 bbls. a year ago when crude runs to stills were at a much lower rate.

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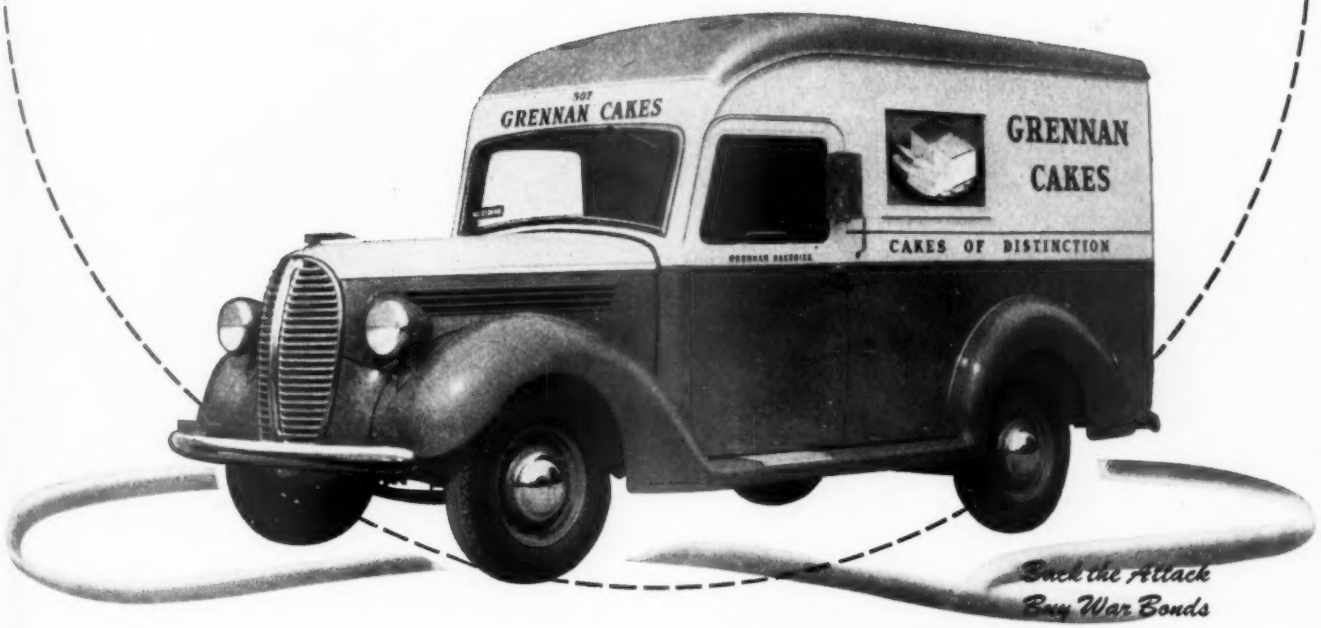

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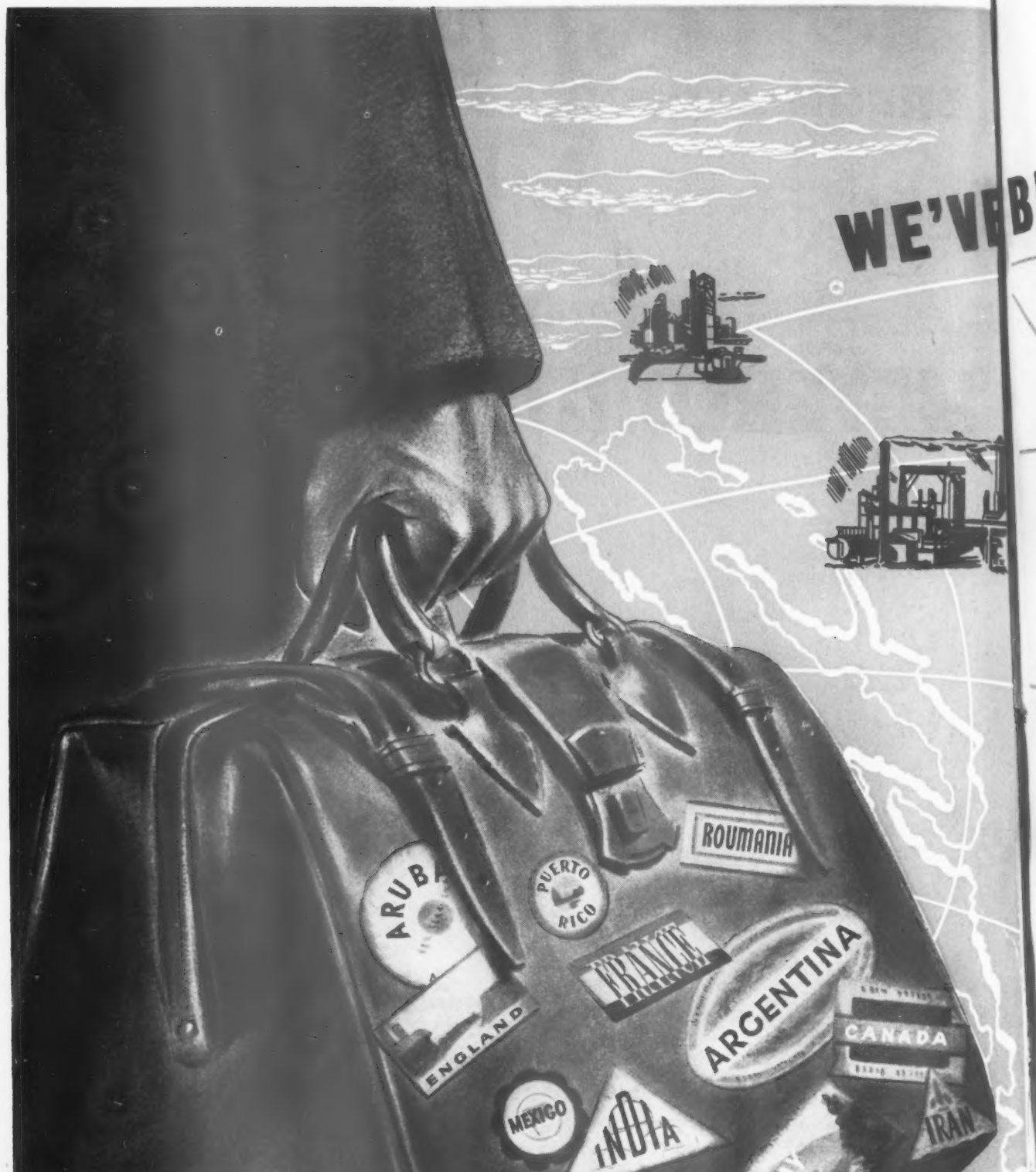
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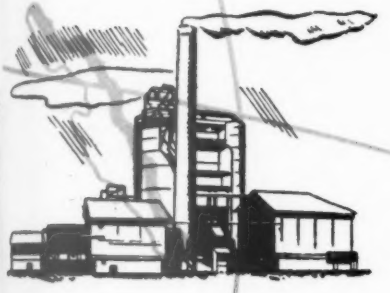

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• These world-wide activities have broadened Badger's "know-how" well beyond that which is normally acquirable from domestic projects alone. Regions where only salt water is readily available — climates that reach 60° below or 110° above — terrains subject to earthquakes or sand-storms and drought — locations inaccessible by normal means . . . these and similar perplexing problems have had to be — and *were* — solved by Badger planning boards, design engineers, procurement specialists, transportation experts, erecting engineers, labor co-ordinators, and other key personnel.

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Process Engineers and Constructors for the Petroleum, Chemical and Petro-Chemical Industries

Tiny Texas U. Fractionating Plant Is Kept Boiling As Pilot for Giant State Chemical Industry

Special to NPN

AUSTIN, Tex.—A cheaper and more efficient method of "wringing out" pure hydrocarbons from petroleum has passed its initial tests and is being tried out here by pilot plant operation, the University of Texas has revealed.

Dr. John Griswold, professor of chemical engineering, has devised a new process for separating the hydrocarbons from certain natural gasoline fractions, and the process is expected to pave the way for a vast postwar expansion of synthetic organic chemical manufacture in Texas, the University announced.

"We are not making synthetic organic chemicals here, it should be emphasized," Dr. Griswold said. "Our job is separating the pure hydrocarbons from other petroleum components.

"These hydrocarbons, in turn, will be used as ingredients for the manufacture of paints, varnishes, lacquers and synthetic organic materials for many other products."

This process involves heating the natural gasoline fractions to temperatures varying with the type of hydrocarbons desired, and running them through a bubble-tray type of fractionating column.

At each of the 150 trays in the column, an additional step in the separations of the hydrocarbons is performed, so that a relatively pure hydrocarbon liquid can be drawn off the top. A second and perhaps third or fourth operation through the same column is necessary to obtain pure hydrocarbons.

The liquid is then subjected to rigid tests—for density, refractive index, and purity. The final test—for purity—is made by means of a Bureau of Standards freezing point apparatus, Dr. Griswold explained.

The entire pilot plant, which is a small scale model of what a large-scale industrial unit of this kind should be, was designed and built in the University laboratory.

Its tiny pumps, scarcely larger than the palm of a man's hand, would have to be enlarged to 3 or 4-foot diameter for commercial operations, while the 18-foot 6-inch refracting column would probably be 75 feet high and four or five feet in diameter.

Raw material for the experiments has been supplied by oil companies which send special fractions separated from the crude at their refineries.

For a run on the pilot plant, continuous operation for as long as 100 hours is necessary, in order to simulate industrial conditions. The run must be checked at 15-minute intervals, requiring the continuous 24-hour-a-day attention of the operator in recording data.

Recently, however, purchase of an automatic multi-point temperature recorder has been authorized under a grant from the University Research Institute, which will permit the operator to devote his attention to chemical and other analyses of the hydrocarbons, Dr. Griswold explained.

"The temperature recorder will permit much better control of the experimental plant, giving quicker and more accurate evaluation of the process and all of its operational variables," he said.

"It will furnish a permanent record for each run, and will result in a much faster progress on the experimental work."

This small-scale modern industrial plant at the University of Texas is engaged in separating pure hydrocarbons from petroleum to provide raw ingredients for a wide range of synthetic organic chemical products in Texas after the war. Developer of the process is Dr. John Griswold (standing). Assistants on the project are (left to right) Charles van Berg of Humble Oil & Refining Co. laboratories, Bill Randall and J. W. Morris

Army Cuts 80-Octane Supply For Posts Within U. S.

NPN News Bureau

WASHINGTON—Number of Army installations in continental U. S. to which 80-octane all-purpose gasoline is supplied is being sharply curtailed by Quartermaster General's fuels and lubricants division. Already, number of army installations in U. S. Treasury regions 1 and 2 to which 80-octane fuel is delivered has been cut from 158 to 44, (these two regions include all of East Coast and most of southeastern section of the country—23 states and District of Columbia).

Procedure similar to the one followed in Regions 1 and 2 is now being followed in other four regions into which country has been divided by the treasury.

In carrying out this policy, posts, camps and stations and other establishments are contacted to determine whether they have equipment which requires 80-octane. They then list requirements with fuels and lubricants divisions. Fuel of 72-octane number is furnished for all vehicles and other equipment for which higher performance gasoline is not authorized.

Recent Patents

REFINING

Alkylation of hydrocarbons, and treatment of hydrocarbons. Joseph D. Danforth, Chicago, Ill., assignor to Universal Oil Products Co. Filed Jan. 10, 1941. (Two patents) Nos. 2,342,123 and 2,342,124.

Solvent extraction of oils. Robert E. Manley, Yonkers, N. Y., assignor to Texas Co. Filed July 19, 1941. No. 2,342,205.

Pressure and temperature recording apparatus (for gases passing through a vapor take-off from a fractionating column). Wallace A. McMillan, Forest Hills, N. Y., assignor to Texas Co. Filed Nov. 9, 1940. No. 2,342,206.

Catalytic isomerization of olefins. Robert E. Burk, Cleveland Heights, Ohio, assignor to Standard Oil Co. (Ohio). Filed Dec. 21, 1940. No. 2,342,248.

Solvent refining of lubricating oils. George C. Oberfell, Bartlesville, Okla., assignor to Phillips Petroleum Co. Filed Oct. 17, 1934. No. 2,342,362.

Process for multiphase alkylation of isoparaffins. Farrand D. Parker, Los Angeles, Calif., assignor to Union Oil Co. (Calif.) Filed Jan. 30, 1939. No. 2,342,364.

Conversion of hydrocarbons. Kenneth D. Uitti, Chicago, Ill., assignor to Universal Oil Products Co. Filed Sept. 9, 1940. No. 2,342,383.

Compiled by R. E. Burnham, patent and trade-mark attorney, 511 11th Street, N.W., Washington 4, D. C., from whom copies may be obtained at rate of 25c each. State number of patent and name of inventor when ordering.

● American fliers, forced down at sea, are being sighted and rescued more often today . . . thanks to a tin can of magic powder.

It paints a huge splotch of glowing color on the water. This guides searching pilots, helps them see life rafts better.

Someday cans will carry a product to help *you* see better . . . paint that glows in the dark! You'll coat stairs and banisters with it to guide you at night.

New and better paints are coming after the war. Some paint experts envision a one-coat house paint, even a sound-absorbing paint.

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And they're coming in cans, of course—along with all the fine paints you've always known. War is really proving the ruggedness, convenience and safety of cans.

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POST-WAR PLANNING: We'll be glad to discuss future uses or improvements of your product or package and help in your post-war planning. Write Post-War Planning Dept., 100 E. 42nd Street, N. Y. C. or Continental Can Company of Canada, Limited, Montreal.

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ARMY E NAVY

Trial Set for April 24 In Pipeline Suit on Osage Royalty Claim

NPN News Bureau

TULSA—Date of trial of U.S. government's $3,400,000 suit against Sinclair Refining Co. was set for April 24, at pretrial conference held here March 31. In the case litigation began in 1936. Federal government in behalf of Osage Nation charges company ran more oil than they accounted for and failed to pay Osage royalties during period 1915-38. Charles O. Butler, special assistant to the attorney general, who has been assigned to handle the case, was given one day in which to file an amendment to the charge and company was allowed five days to plead it. Both sides waived jury trial.

Court audit of Sinclair's books over the 23-year period shows a gross overage in excess of 28,000,000 bbl. of oil, indicating that run tickets prepared by the company are false, Mr. Butler said. Audit was taken of records of stations into which Osage oil was pumped and first gauged, and after deducting all shortages net overage was 430,813 bbl., equal to $109,704 of Osage royalty, Mr. Butler said, adding that he thought final net overage would have been twice as much if they could have distinguished how shortages occurred (such as pipeline breaks).

Judge Summers Hardy, associate counsel for Sinclair, contended that run tickets were accurately and correctly made and that discrepancy in records was due to the fact that records kept at lease tanks were much more accurate than those at pump stations. Measurements at pump stations, he added, were kept for company records only as an estimate of amount of oil handled. Sinclair, he said, suffered a shortage of more than 15,000,000 bbl. of oil during the period.

Case is one of six in which government charges substantially same but amounts of money involved varies, Butler said. Action is pending against Texas Pipe Line Co., Gulf Refining Co., Cosden Pipe Line Co., Oklahoma Pipe Line Co., and Stanolind Pipe Line Co. Amount claimed by the government in Sinclair case is the largest, he said.

Pipeline Earnings Rise 14.6% During 4th Quarter Of '43

NPN News Bureau

WASHINGTON—ICC March 29 issued 4th quarter 1943 report of transportation revenue and traffic of large oil pipeline companies showing an aggregate increase of 14.6% over earnings of same quarter during 1942 by companies having annual operating revenues in excess of $500,000. Report was subject to revision.

ICC's report was compiled from 46 quarterly reports representing 46 pipeline companies, and showed that of the total, 17 suffered a loss compared with the Oct.-through-Dec. period of 1942, while 26 showed increases. Comparison was not shown for remaining three companies since no figures were listed for 1942.

Companies showing largest revenue increases were: Buffalo Pipeline Corp., up 215.3% over 1942 fourth quarter; Tuscarora Oil Co., Ltd., up 142.8%; Atlantic Pipeline Co., up 69.8%; Humble Pipeline Co., up 62.1%; Texas Pipeline Co. up 50%; Pan American Pipeline Co., up 46.1%; Texas-New Mexico Pipeline Co., up 37.4%; Tidal Pipeline Co., up 30.4%; and Plantation Pipeline Co., up 22.8%.

Companies showing greatest revenue losses were: Continental Oil Co., down 30.3%; Bradford Transit Co., down 26.4%; White Eagle Pipeline Div. of Socony-Vacuum Oil Co., Inc., down 25.2%; Arkansas Pipeline Corp., down 21.2%; Texas-Empire Pipeline Co., down 21.1%; and Southeastern Pipeline Co., down 18.4%.

Short-Haul Problems May Cause Local Shortages in East

NPN News Bureau

WASHINGTON — Despite losses resulting from a drop in tank car hauls eastward during the week ending March 25, stocks along the Atlantic Seaboard "are currently sufficient" to meet rationed demands, Deputy PAW Davies reported March 30, but he warned that local shortages may develop. These may result because of short-haul transportation problems rather than from lack of programmed supplies.

Mr. Davies' weekly report on East Coast oil supplies was devoted primarily to an explanation in rail hauls. Snow storms on two successive weekends slowed up tank car unloadings for two days in each instance. At the same time, changes in product requirements in various parts of the East made necessary the shifting of cars from certain loading points to others, which resulted in additional loss of time. With improved weather, he added, shipments are once again on uprise.

With heating season almost over, Mr. Davies pointed out that gasoline supply again becomes No. 1 problem of the industry. "However," he added, "every effort will be made to avoid temporary shortages, and certainly we shall see to it that farmers' spring planting and other essential activities are not held up for lack of supplies."

Rail Hauls To East Coast Drop 58,504 b/d

NPN News Bureau

WASHINGTON—Tank car hauls of crude and products to the East Coast averaged only 699,109 b/d during the week ended March 25, compared with 757,613 b/d the previous week. A total of 67 oil companies loaded 22,700 tank cars as follows:

Abercrombie	198	Freedom Oil	6	Roosevelt Oil	4
Aetna	16	Globe	173	Royal Petroleum	72
Allied	91	Gulf	2,082	Shell	888
Amsco	259	Hartol	20	Shotmeyer	4
Arkansas Fuel Oil	5	Hess, Inc.	24	Sinclair	1,382
Ashland Refining	129	Home Oil	24	Socony-Vacuum	3,013
Asiatic Petroleum	75	Jenney Mnfg. Co.	10	Southland	8
Atlantic Refining	1,551	Kanotex	9	S. O. California	38
Aurora	5	Libby	3	S. O. Indiana	455
Bareco	5	National Refining	10	S. O. Kentucky	45
Bell Oil & Gas	1	Ohio Oil	65	S. O. New Jersey	4,088
James B. Berry Sons	1	Pacific	67	S. O. Ohio	212
Cantelou	6	Pan American	1,195	Sterling	1
Canton	19	Petroleum Corp.	62	Sun	2,214
Chalmette	60	Petroleum Heat & Power	18	Talco	57
Cities Service	587	Phillips	277	Texaco	1,614
Consumers Cooperative	14	Premier	8	Tide Water	724
Continental	389	Primrose	43	Tiona	16
Crown Petroleum	5	Pure	54	Triangle	25
Daugherty	17	Republic	115	Waggoner	9
Derby	20	Richfield	62	Western Oil	5
Drake	6	Rock Island	3	White Fuel	32
Elk Refining	49				

Tires Flame in Chicago Yard

NPN News Bureau

CHICAGO — Fire of undetermined origin destroyed or damaged part of a large stock pile of used tires in the yard of I. Mandelowitz & Son, scrap rubber dealers, at Canal and 16th Streets on March 25. C. Manel, co-partner in the firm, estimated the damage at 400 tons. Tires were part of 1500 tons of scrap the firm purchased from Rubber Reserve Corp. some time ago and are now splitting for Goodrich Tire & Rubber Co. for reprocessing.

Prepared for Fire!

Official U. S. Navy Photographs

"Ready if the Heat's On"

Crash landing of a bomber, damaged by enemy fire, on the carrier deck may result in a burst of flame endangering the ship as well as plane.

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River Transportation—

"Wayne H.," Powerful Diesel Towboat, Is First To Open '44 Navigation on Upper Mississippi

By David I. Day

THE "Wayne H", a powerful diesel towboat of the Paralind Oil Company's fleet, had the honor of opening commercial navigation on the upper Mississippi River for 1944. She passed through the locks at Rock Island, Ill., early on March 15. Her progress was slow, however, because of floating ice, fog, and the absence of river buoys.

The boat needed all her power of 1200 h.p. to work her way against floating ice pushing her loaded oil barges. Another early bird in this trade was the well-known "Kansas City Socony"—both boats headed for Bettendorf, Ia. Your correspondent did not see the latter boat but the "Wayne H" had five barges.

At Cairo, Ill., observed the new DPC steamer, the "Kokoda" coming in from Norco, La., with 117,981 barrels, the equivalent of around 16,840 tons of gasoline. It was reported that the giant towboat had made an average of approximately two and one-third miles an hour coming up the Mississippi against the strong high river current. The boat is under charter to the Lake Tankers Corp.

It was estimated that in pushing the tow against the river for 800 miles, the boat had climbed a river rise of something over 26 feet and in that entire distance had been forced to double-trip but twice. The "Kokoda" is pushed by two nine-foot propellers each operated by a 1200 h.p. Fulton engine. In command was Capt. M. D. Burdge with Capts. O. C. Clark and Code Grant as pilots, James Walker as mate, and with Frank Whiteman, D. E. Berot, and Patrick Joure in the engine room.

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Cobb's Death Mourned

The recent death of the great humorist, Irvin S. Cobb, a member of a river family, at his home port of Paducah, Ky., was deeply mourned along the lower Ohio, among men in oil transportation as well as others. I was reminded of this great author on my last trip to Louisville in seeing the towboat "Irvin S. Cobb" headed upstream pushing four or five barges of oil. It was a memorable trip as the boat traveled for the first time to the upper reaches of the river. The "Cobb" is a steel hull boat 100 feet in length, with a 615 h.p. National Superior engine. She is the most powerful Diesel stern wheel boat now in service. She is the property of Igert, Inc., of Paducah.

At various points along the Ohio were observed the four biggest Ashland Oil towboats, all headed up with nice tows. The "Tri-State" in particular was a most attractive vessel heading her tow up to the Newburgh Dam above Evansville. At the time, she was commanded by Capt. T. Kent Booth of Pittsburgh, a member of a famous family of Ohio River masters and pilots.

No matter where one has traveled on the river for several years, he has doubtless seen the dauntless little "R. W. Turner", owned by the Turners of Madison, Ind. It has always been, so far as memory beckons, an oil boat. She used to push oil out of Green River. She pushed oil out and gasoline in on the scenic Kentucky. We've seen her laboring lately on the lower Ohio. More recently she has been towing gasoline between Louisville and Ashland, Ky., where rumor indicates she will remain for the duration.

Above Louisville was the converted "Walter F. Carey", formerly the steamer "Tallulah". She has towed automobiles and jeeps but is now in the oil trade. She is owned by the Commercial Barge Lines, Evansville and Detroit. The Standard Oil of Ohio played in luck in chartering the DPC boat, "Coral Sea", as she has been making some record and near-record tows of late. Considering the high water stage and the general weather conditions, river traffic above Louisville was brisk enough with the oil boats setting the pace.

° ° °

A Bit of Trouble

Up around historic Gallipolis were working the "Fred W. Olcott," the "Vagabond", the "Stanolind A", the "D. W. Wisherd", the "Neville", the "Sohio", the "Duncan Bruce", the "John W. Hubbard", and several more in the oil trade.

The "Olcott" had the unenvied experience of catching a barge on a bear-trap pier of one of the dams. It was a falling river, too, and things looked bad for a time but out from Parkersburg, West Va., came pumping equipment. Enough gasoline was pumped from the barge to release it. At one point, the tows of the "Vagabond" and the "Olcott" looked like they were in a race. One was on one side of the river just opposite the other. It was a very unusual sight. The "Vagabond's" tow of five barges were single-file" making it a very long one, especially to be pushed by a boat less than 65 feet in length.

° ° °

The "Paul Blazer"

The name "Paul Blazer" will never be overlooked by future historians of this river transportation period. No better known towboat ranges the rivers than this one, seen in the Gallipolis pool, a star member of the Ashland Oil fleet and named for the president of the company. Noted in the same vicinity the "Patriot" and "American" of the American Barge Lines, all with oil tows.

The "Blazer" was built a few years ago at the Calumet Shipyard & Dry Dock Company, Chicago, and is powered by twin Superior 8-cylinder, 14½ x 20 Diesels, each rated at 800 h.p., at 300 r.p.m. The American Barge Lines boats "with good American names" are most of them —maybe all—powered by Cooper-Bessemers. The biggest of the lot, the "Jefferson", is down around New Orleans, assembling oil tows. She is of 2000 h.p.

It will be good news to all but Hitler and his pals that the new DPC towboat, the "Guadalcanal", is launched and at work. Like the others in the Emergency Oil Fleet of the government, she is 180 ft. long, rated at 2000 h.p., and capable of more than that in case of necessity. She was ready for trial trips in mid-March and then to work. Built mainly at the Jeffersonville yards, the finishing touches were put on at the Marietta Manufacturing Co. yards at Point Pleasant, W. Va., and her work will be on the Mississippi for the Federal Barge Lines. Another of the big steam giants, the "Tulagi" is nearing completion at Point Pleasant. It is believed that all the fleet will be ready for work this spring.

Letters received at Cincinnati revealed that the big "Jack Rathbone", steamer of the Standard Oil of Louisiana was on her way up with 72,000 barrels of oil from Baton Rouge to Louisville, under command of Capt. J. W. Stephens, a real veteran of more than 40 years on the rivers. He started back in the palmy days of the packets having learned to pilot on the famous "Belle of the Bends".

Calls for Immediate Building Of Texas-Pacific Pipeline

Special to NPN

AUSTIN, TEX.—Railroad Commissioner Ernest O. Thompson has reiterated his belief that the proposed war emergency pipeline from West Texas to the Pacific coast should be built as soon as possible.

The veteran Texas oil authority said that West Texas wells could easily supply 180,000 b/d to such a line, in addition to the needs of the new pipelines just finished—Stanolind and Magnolia.

"New discoveries are constantly being made in West Texas, and the West Coast is the logical market," he said.

Col. Thompson made his comment after plans were announced in Washington for the new line. A new corporation, organized by a group of Texans, would build a 20-inch line from Monahans in Ward County to Los Angeles, a distance of 930 miles.

The commissioner has also been asked by the Independent Oil Association of America to appear before the newly created Senate oil investigating committee to protest against the proposed Arabian oil pipeline.

Summa Cum Laude...WHAT THEN?

A DEGREE CAN TELL YOU A LOT about an engineer's potentialities. His years of experience are an even better yardstick.

But the mere mastery of mathematics and chemistry over the years isn't enough when you engineer an oil refinery. And you can take that on the say-so of our men.

These engineers were hand-picked for individual competence. Nevertheless, it has taken more than their special skills to make M. W. Kellogg service a by-word among the world's leading petroleum refiners. *And why?* The answers lie in other divisions of M. W. Kellogg which support our engineers.

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As a result of such exclusive data and facilities, our engineers approach each new problem with an unduplicated "know-how." But these engineers too, are only one link in the endless chain of M. W. Kellogg service. We evolve the required chemical engineering data. We apply it. We develop process methods. We design. We build the plants. We supervise initial operations. And all M. W. Kellogg designed and built plants must do two things: Hasten Victory . . . give our clients an edge in postwar competition.

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Only Kellogg Service Has Them All

LABORATORIES—fully equipped and staffed—devoted exclusively to chemical engineering and process development.

24-HOUR-A-DAY PILOT PLANTS—17 refining processes operating continuously—providing accurate data for commercial scale application.

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Dist. 3 Is Scraping Manpower Barrel For Drilling Crews

Special to NPN

HOUSTON, Tex.—Currently running about 25% below the schedule set out by PAW for 24,000 wells this year, producers and drilling contractors in Dist. 3 met here to discuss ways and means to replace manpower which will be lost through the operation of Selective Service.

A. H. Rowan, chairman of the subcommittee on manpower for the Dist. 3 production committee, pointed out that the drilling contractors are no longer concerned merely with the drafting of men under 26 years of age because "there just aren't any more in that category." He added: "What we are interested in is men up to 38 years of age."

Mr. Rowan asserted about 27,000 men were needed in the drilling industry in the U. S. if PAW schedules were to be met.

"If the present rate of drafting men under 38 years of age from drilling industry is maintained, it will be necessary to drastically curtail drilling operations in the immediate future," Mr. Rowan said.

The production committee adopted a program which calls for setting up a recruiting system, staffed by voluntary members of the industry in various localities of Dist. 3. This group will be responsible for contacting all offices of the U. S. employment service in the area and enlisting their aid.

Further, PAW will be asked to act as an intermediary with Selective Service state headquarters in each of the states covered by Dist. 3, while the War Man-Power Commission will be asked to advise PAW of contemplated cutbacks in other war industries, so that drilling and production can carry on its recruitment program.

Wasson Oil-Gas Ratio Stands; Move for Cut Headed Off

Special to NPN

AUSTIN—The present oil-gas ratio of 5000 feet of gas to one barrel of oil in the Wasson field, one of the state's largest, is likely to be kept, the Texas Railroad Commission indicated here after a long hearing with companies interested in the field.

Jack Baumel, production engineer for the Commission, testified that the latest surveys show that the field produced around 74,000 b/d, that 98% of the wells used less than 5000 cubic feet of gas to lift one barrel of oil.

Amon Carter, Fort Worth publisher-oil man, asserted that lowering the ratio would benefit a few "big companies" but would work to the detriment of the smaller producers.

"We developed that field without any help from the big companies," he testified. Now the country needs all the oil it can get. While they declined to help in the pioneering, to cut down on the ratio of the independents and myself would amount to pilfering. It would mean the loss of millions of barrels of oil to us, and would amount to confiscation."

Reflecting the losses a wildcatter must be prepared to take, Mr. Carter testified that he had drilled 90 wildcats that were dry holes before hitting the discovery well.

No witnesses appeared in defense of the proposed cut, and all three commissioners indicated they would let the ratio stand.

Oklahoma Allowables Steady

Special to NPN

OKLAHOMA CITY—Crude allowable for months of April and May has been set by Oklahoma Corporation Commission at 356,000 b/d, same figure as PAW recommendation and 1000 b/d over March allowable.

Illinois Oil Well Tax Killed

Special to NPN

SPRINGFIELD, Ill. — The 3% oil production tax, in effect in Illinois since July of 1941, was invalidated by decision of the Illinois Supreme Court on March 21 on the grounds that it violated the constitution by lack of uniformity.

The tax was first challenged in the Sangamon County Circuit Court in 1941 by a group of oil companies, among them, Ohio Oil Co., Superior Oil Co. and Shell Oil Co., Inc., and by a property owner in the state. The Sangamon court declared the tax to be valid and the three companies took the case to the state supreme court which held that the tax was levied on royalty owners on the contention that they are engaged in the production of oil, and that such is not always the case.

An approximate 10 million dollars paid the state treasury under protest will be returned to the claimants, according to R. A. Stephens, local counsel for the oil companies.

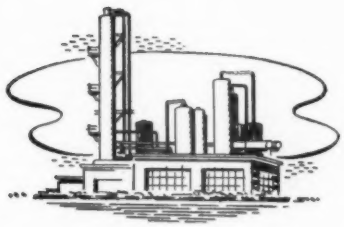
Crude Sharing Among Dist. 2 Refiners Shows Big Decline

NPN News Bureau

CHICAGO—Crude to be shared with supplicant refiners in Dist. 2 for the month of April totals only 29,050 b/d, according to the list prepared by the crude oil panels last week and approved by PAW. This compares with 46,600 b/d for March. Improvement in the amount is anticipated as soon as tank cars become available for increased movement of sour crude from West Texas and DSC approves additional compensatory agreement on shipments of crude by barge from Louisiana and by tank car from Wyoming.

List of supplying and receiving companies under the present voluntary crude sharing plan for April follows:

Supplying company	Receiving company	b/d
Aetna Oil Co.	Louisville Refining	800
Bay Refining Co.	Crystal Refining	200
Cities Service	El Dorado Refining Co.	2,000
Continental	National Co-op.	1,500
Gulf	Arrow Petroleum	1,000
Ind. Farm Bureau	Louisville Refining	800
Ohio Oil Co.	National Refining	2,400
Phillips	El Dorado Refining	500
Phillips	National Refining	1,500
Pure Oil Co.	Midwest Refining	375
Pure Oil Co.	National Refining	2,575
Rayburn Pipe Line Co.	Crystal Refining Co.	400
Rayburn Pipe Line Co.	Marvel Refining Co.	400
Rayburn Pipe Line Co.	Midwest Refining Co.	100
Roosevelt Oil	Crystal Refining	200
Roosevelt Oil	Midwest Refining	675
Shell Oil Co.	Globe Oil & Refining Co.	1,500
Shell Oil Co.	National Refining Co.	100
Sinclair Refining Co.	El Dorado Refining Co.	260
Sinclair Refining Co.	Worth Refining Co.	2,400
Simrall Corp.	Lakeside Refining Co.	300
Simrall Corp.	Marvel Refining Co.	180
Simrall Corp.	Old Dutch Refining Co.	160
Simrall Corp.	Osceola Refining Co.	100
Skelly Oil Co.	El Dorado Refining Co.	500
Socony-Vacuum	Midwest Refining Co.	100
Socony-Vacuum	Old Dutch Refining	400
Standard Oil (Ind.)	Derby Oil Co.	500
Standard (Ohio)	Advance Refining Co.	1,575
Standard (Ohio)	Cascade Refining Co.	250
Standard (Ohio)	Louisville Refining Co.	800
Standard (Ohio)	National Refining Co.	2,100
Standard (Ohio)	Stoll Oil & Gas	900
Sun Oil Co.	Crystal Refining Co.	300
Texas Co.	Bell Oil & Gas Co.	200
Texas Co.	Johnson Oil & Supply Co.	1,000
		29,050



'24 to '44

20 Years of Protection for the 100% Pure Pennsylvania Emblem

The emblem of this Association is indelibly impressed on the consciousness of the American public. An independent survey revealed that 76% of the motoring public knows it and identifies it. To millions it is a guide in buying lubricating oils.

For two-thirds of a generation this Association has rigidly guarded the integrity of this emblem. Our field men, our research and laboratory technologists—with backing of the Courts—have kept it safe and continue to do so.

The public knows this—*which is why 100% Pure Pennsylvania Oils should play an important part in your post-war selling plans.*

PENNSYLVANIA GRADE CRUDE OIL ASSOCIATION

OIL CITY, PENNSYLVANIA

Because of its high quality, war demands great quantities of 100% Pure Pennsylvania Motor Oils and this demand comes first, of course. Our region is producing and refining to the limit. Our oils are still available most everywhere for essential motoring needs.

A.A.A. Reports Increase in Sale of Gasoline Dopes Due to Fuel Shortage; Finds All Are Worthless

NPN News Bureau

NEW YORK—The attention which gasoline rationing has focused on motor fuel economy has caused renewed and widespread interest in the "magic" of fuel additives, popularly known as "gasoline dopes." These dopes take the form of powder, liquid or tablets dropped in the gasoline tank for the purpose of "pepping up" the motor fuel. An inclusive definition of a gasoline dope is: Any substance which is used or proposed for mixture in amounts less than 1% with gasoline to improve its properties.

Products of this kind always have been on the market, but the American Automobile Assn. reports that present conditions have caused an increase in their number and in the scope of their sales and advertising campaigns. All such dopes are worthless and in cases may even be harmful. They cannot improve starting, decrease crankcase dilution, or prevent vapor lock. Maximum power cannot be affected by small additions of any known substances, except as they affect fuel knock.

The National Bureau of Standards reports that "in the testing of some 150 such dopes, exclusive of the well-known knock suppressors, not a single instance of any important improvement has been observed in any feature of engine performance."

Require Leaner Mixture

Instructions in the use of dopes are often given cleverly—the driver being told to use a leaner mixture after dropping in the additive. When such instructions are followed they often appear to produce favorable results. The adjustment of the carburetor gives a bit better mileage and the gullible motorist ascribes that fact to the dope.

Recently with the increase of dopes, there have been many exposes of these products. They have been shown to be worthless through laboratory tests, through road tests, on the authority of the Bureau of Standards, the National Better Business Bureau, nearly all automobile associations, fuel chemists and engine experts. Even New York City's Mayor La Guardia went on the radio Feb. 6, over station WNYC, to condemn one of the fastest selling of all current dopes.

Mostly Crude Naphthalene

Typical of the claims of dopes is that on the label of one of the fastest selling additives now on the market: "Road tests have shown increased mileage as much as 39%." The claim is repeated: "Add two gasoline tablets to each gallon of gasoline in the tank; this will give up to 39% more mileage from the gasoline."

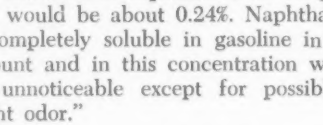
One large oil company with complete laboratory equipment has analyzed the product making this increased mileage claim and reports to NPN that the tablets are substantially "crude naphthalene" (moth balls). To this, the laboratory report says, has been added a coloring agent and "possibly a small per cent (less than 5% by weight of the naphthalene) of a chlorinated (or sulfur-chlorinated) material. The report adds: "If two tablets per gallon were used, the concentration of naphthalene in the gasoline would be about 0.24%. Naphthalene is completely soluble in gasoline in this amount and in this concentration would be unnoticeable except for possibly a slight odor."

May Increase Gum Content

The analysis indicates, however, a small amount of insoluble residue "which would indicate that the naphthalene used contains some traces of insoluble impurities. It is possible that this contamination occurred during manufacture of the tablets."

The laboratory report says, further: "These types of materials are well known to the industry and many of them have been tried as addition agents for gasoline.

WHERE THE FUEL GOES



AN ARMY LIGHT TANK may burn one gallon of gasoline a minute.

OWI

We know of no information which would indicate any appreciable beneficial effect of these materials on gasoline when used in the extremely small concentrations indicated here. There is some possibility that these chlorinated types of materials, when used in higher concentrations, may be effective in loosening or minimizing carbon deposits. However, even the most optimistic promoters of the use of these materials have not considered them in concentrations much less than 0.1% in gasoline." (Concentration of the usual dope is less than 0.01%).

The laboratory reports that tests of one dope "show negligible results in anti-knock quality. The octane number of gasoline is unchanged by the tablets (the data actually show a slight drop in octane number, which would mean a decrease in anti-knock value). There is no indication that any beneficial anti-knock results can be obtained from this material."

The report adds that tests show that this additive makes the gasoline slightly corrosive, and slightly increases the "gum" content of the gasoline. "The addition of naphthalene will reduce the heating value and hence the potential mileage of gasoline slightly, but in these small concentrations this effect is negligible."

The claims of increased mileage are utterly disproved by the National Bureau of Standards of the U.S. Commerce Dept., which reports:

"Gasoline dopes which are sold for addition to gasoline in small quantities (one ounce per gallon or less) can be accepted as of value only on conclusive evidence that they are effective. They cannot be expected to improve starting, decrease crankcase dilution, or prevent vapor lock. So far as information is at hand, no materials which in small quantities reduce knock are sold separately for mixture with gasoline. Maximum power cannot be affected by small additions of any known substances except as they affect fuel knock. Carbon formation and fuel economy are so dependent on adjustments and operating conditions that proof of the value of dopes is more difficult. In the testing of more than 150 such dopes at the National Bureau of Standards, exclusive of the well-known knock suppressors, not a single instance of any important improvement has been observed in any feature of engine performance."

Report on Eight Tests

The National Better Business Bureau, Inc., says in a report of March 18, 1943:

"The findings of the National Bureau of Standards are in agreement with the results obtained by a number of Better Business Bureaus which have conducted road tests. The Better Business Bureaus' road tests on some automobiles showed some nominal plus or minus differences between runs on regular gasoline and duplicate runs on gasoline to which the dope has been added. Since it is impossible to duplicate exactly all conditions of a road test in a succeeding test, the nominal differences shown in the Better Business Bureaus' tests cannot be definitely attributed to the additive but if they were, the tests would indicate that either slight gain or slight loss would result from its use.

"It seems obvious that if any 'dope' could be added to gasoline to make it give a substantial increase in mileage, the U. S. Government would be the largest customer for the product at this time. Instead of putting these 'dopes' in jeeps and bombers, the Government, through the National Bureau of Standards, finds that they are without beneficial effect."

In anotheer statement the National Better Business Bureau challenges a claim that tests were conducted by the National Better Business Bureau. The National Better Business Bureau denies that it conducted such tests, explaining:

"A representative of the National Bureau was present during the test as an observer, but he had nothing to do with

the details of the test, and we do not in any way vouch for the results reported.

"The Nov. 12 test took place a few days after another test which was made by a representative of the Bureau at which the manufacturer was present. This earlier test was based on two runs of 120 miles each and it showed a difference of 3.4% in gasoline consumption between the run made on regular gasoline and an identical run on the treated gasoline. Seven other test runs were made by Better Business Bureau executives in various parts of the country. In five cases, 7.73,% 7.69,% 4.1,% 7.62% and 4.58% less gasoline was used in the runs made with the treated gasoline over regular gasoline. In the two other cases, 1.63% and 6.05% more gasoline was consumed in the runs made with treated gasoline as compared to identical runs with regular gasoline. The differences in gasoline consumption in all light tests conducted by the Better Business Bureaus were nominal in amount, and since the test conditions were not and could not be absolutely identical on both runs, we cannot ascribe these differences to any single factor. The Bureau tests indicate that if the difference in gasoline consumption between the use of regular gasoline and the same gasoline treated with gasoline tablets may be attributed wholly to the tablets, a relative minor savings or loss may result.

"The promoters of these tablets have shown us numerous letters and reports from individuals and organizations who have alleged that as a result of using the gasoline tablets they effected a substantial savings in gasoline consumption. The tests sponsored by the various bureaus failed to show any such savings."

Proposes Changed Control of Rhode Island 'Gas' Sale

PROVIDENCE, R. I.—An act which would place under the state administrator the regulation of restrictions on gasoline pump signs and of business practices of the operators was introduced into the House recently by Rep. James J. Horgan II.

Rep. Horgan's act would take the control of station regulations from the Department of Business Regulation and place it under jurisdiction of the tax administrator.

Reports Official 'Gas' Saving

NEW YORK—Daniel P. Wooley, regional head of OPA, announced here recently that four state governments, New York, Pennsylvania, New Jersey, and Maryland, and the District of Columbia had saved more than 9000 gals. of gasoline and 2500 automobile tires by reducing official automobile travel between July 1 and Sept. 30 of last year.

The saving, estimated at 15,568,452 miles is attributed to car pooling, use of public conveyances, and rigid control over distribution of gasoline and oil.

PUMPS... *Now!*

TRI-ROTOR TRUCK or BULK STATION PUMPS designed and built by THE YALE & TOWNE MFG. CO., are *now available* upon receipt of your order with AA-5 Priority or better; highest ratings given preference.

TRI-ROTOR PUMPS are manufactured in the following sizes: 1¼"—20 GPM; 1½"—40 GPM; 2"—80 GPM; 2½"—90 GPM; 3"—100 GPM; 4"—200 GPM.

THE TRI-ROTOR PUMP is simple in design—high in efficiency—low in maintenance cost. Supplied with solid, by-pass or variable type heads.

WHEN ORDERING, SPECIFY: iron or bronze fitted—type of head required—direction of rotation (will pump shaft turn clockwise or counter-clockwise when looking at pump from shaft end).

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MANUFACTURERS OF THE FAMOUS YALE LOCKS AND HARDWARE

COMPLIANCE SERVICE ON WAR OIL RE

Rationing and Price Powers of OPA Should Be Defined Specifically by Congress in New Law

This is the third in a series of articles by Mr. Hadlick to assist oil men to bring about full compliance on the part of themselves, their employes and the consuming public with all government regulations concerning oil.

Mr. Hadlick is a prominent member of the Minnesota Bar and for many years has been president and chief executive officer of the Northwest Petroleum Assn. which represents marketers in Minnesota and North Dakota. He is well qualified to advise management on its responsibilities under the regulations and also to point out benefits that may be obtained and which might otherwise be overlooked by busy executives.

In this week's article Mr. Hadlick reminds that the OPA law comes up for extension soon, advises oil associations and individuals to get busy on suggesting changes in the new law that will end abuses.

By Elwin E. Hadlick

THE NOISE AND DIN of a carnival would seem shallow when placed alongside the howls which have gone up from the industry at times over rationing regulations. In some cases the complaints have been constructive and effective; in some they have been just plain gripes at the horrors of civilian warfare, and they deserved to be ineffective; in too many cases the justifiable complaints have fallen on unsympathetic ears and have gone unheeded.

Mr. Hadlick

The thinking of the industry has worked itself into the fabric of fuel oil rationing much more effectively than it has in gasoline rationing. The reasons aren't hard to find, though there is much disagreement over them, and a cautious person probably ought to try to avoid them. We'll stick our neck out just far enough to say that probably the truth is that fuel oil rationing is actually simpler because it affects fewer persons, involves larger individual purchases, and has different delivery problems involved—added to which one might say that the thinking of the fuel oil distributors has been welded closer together than has that of the gasoline distributors.

The one phase of both fuel oil and gasoline rationing which has not met with universal or even very general approval is the enforcement. Editorial writers have styled OPA's procedure as the operation of "kangaroo courts." Whatever the description, the system is that employes of OPA investigate, other employes of the same agency complain, still other employes prosecute, another employe judges, and there you are. Under the stress of war-time conditions, and solely on the facts of the individual cases which have been before the courts, OPA's methods have not been knocked out by the courts. That doesn't say that the procedure has been specifically passed on by any court nor that any litigant has yet properly and squarely rested his case on the procedure so as to get a proper court decision.

At another time these administrative proceedings will be looked at in the light of the body of administrative law which has been built up in this country over a period of years. But at this time we want to take a look at it from the standpoint of what may be done about it in connection with the renewal of the life of OPA:

Everyone knows that the life of OPA expires on June 30, and that from that day on the agency will be as dead as the traditional dodo bird unless Congress does something about it. Congress will do something. Consideration is already under way. But to what extent has Congress kept its hands on the situation and to what extent can they or will they do anything about it?

OPA received its authority to stabilize prices from the law which is about to expire. There is no statement in that law that OPA is to do any rationing. The right to ration is claimed not because of any express grant from Congress to OPA. The authority is claimed to stem from Executive Orders which have been issued under the various War Powers Acts. In other words, OPA makes no determination of the need for rationing of any products; that decision is made elsewhere in Government, with OPA performing the function of the rationing agent.

In using suspension orders, the name given to an order which suspends a concern from doing something which it would otherwise have a legal right to do, OPA claims to be following procedure which is authorized, constitutional and in the American tradition. That claim is roundly and widely denied by many. Whatever portion of the claim they may be able to sustain, some of the developments and refinements are interesting; possibly they indicate a change in the thinking of the boys in OPA, and possibly they represent only such practical "politicing" as may be necessary in order to convince Congress that the agency should be continued.

Two significant things have happened in the attitude of OPA, neither of them exactly of such a nature that anyone can go to the books and prove that the changes have been made. In the first place OPA has indicated that it will in the future, at least in some types of cases, seek remedy by injunction rather than by suspension; that means they will resort to the courts of law which really do exist in the American tradition. Will such resort to courts of law be the method when the life of the agency has been extended? Is OPA acting like the little boy who is good just before Christmas? Those are questions that ought to be answered in the affirmative by precise provisions of the law.

The other feature is even more important. Again there is no page number in the books to be referred to. In the early days OPA didn't understand just how sharp and fine an instrument the suspension proceeding really was, and they seemed to believe that the proceeding was only useable as a means of entirely suspending a concern from business for a period of time. Right away such an idea brings up another one, namely, that no one can suspend a concern from business where the result of such suspension would be economic disaster for the community in which they normally operate. That means in plain language that the proceeding couldn't be used against big operators.

Now the instrument of suspension has been sharpened, ground down to a fine point, and better understood, so that it can be used even against the large concern. Now OPA doesn't necessarily seek suspension of the entire business, but rather a suspension of certain phases involved in the rationing violation.

Some persons in Congress propose to do something about the matter. Consider-

What Does the Trade Think?

Oil associations are studying proposals to amend the act that created the Office of Price Administration which expires June 30.

Unless the objections and suggestions for correction come in from those who have suffered from maladministration of the act, there is the chance that the evils of OPA may not be cured.

Oil associations are asking their members for their personal experiences and suggestions. Every oil man should respond at once.

But in addition to writing his association he should also write direct to his Congressman and Senators at Washington. And send us a copy.—Ed.

ation being given to bills to extend OPA includes talk about curbing the "kangaroo courts," making the proceedings legal, sticking to American traditions, etc. What industry will present to Congress is not yet too well known. Whatever it is ought to be so specific as to be airtight; no generalities will do much to change the present situation.

The truth is that the price control law is probably not the place to stick in a few provisions about the operations of administrative tribunals. Present OPA officials claim that their proceedings at the present time are all in accord with the recommendations of the Committee on Administrative Procedure, made some years ago; that committee was appointed by the Attorney General at the request of the President.

Arguments could go on forever about the matter. Congress, if it likes the report of the Attorney General's committee, as some say it does, could assume the job to be done by providing in a few words that OPA enforcement, whether in the price or rationing field, must be in accord with the rules of the Attorney General's Committee. That would get nothing done, for OPA already contends it is doing that.

There is a simple approach and it is to be hoped that it will be made. The approach is simple because the question is important in connection with so many things in Government in addition to the OPA. American business men probably do not begin to realize the extent to which their activities are supervised by administrative proceedings. But whether they realize the situation to the full extent or not, this is an extremely good time to take care of all administrative tribunals while striking the iron which is presently hot, the OPA.

The American Bar Assn. has had committees working for some years on a proposed bill to prescribe fair administrative procedure. The matter is still in the study stage. The need for reform is urgent, and whether studies have been completed or not, now would seem to be the time to pass Federal legislation to correct the abuses. If later experience shows that refinements in the law are desirable, as it will so show regardless of the shape of the legislation in its first passage, corrections can be made in the usual manner.

It will be a great deal more beneficial to get the whole administrative procedure tied into a neat package than it will be to correct a few current OPA abuses. In correcting a few there is no assurance that others won't creep in.

THANK YOU, Mr. Judd—

FROM: O. D. Judd, Price executive, petroleum branch, OPA. TO: The Editor.

Your new editorial department, "War Oil Regulations Compliance Service," will certainly render a valuable service to the Petroleum Industry, and should be warmly welcomed by all oil men. In placing this department under the supervision of a man with Mr. Elwin's Hadlick's knowledge and background, the Industry is assured that the questions which they may raise will be intelligently and correctly answered.

Permit me to assure you that we will welcome any inquiries which Mr. Hadlick might direct to us, and that such inquiries will be handled frankly and without delay. We fully realize that legal terminology is at best confusing to the lay man, but as you point out, certain legal formalities must be observed in the preparation of our regulations and interpretations. Although, I am certain that Mr. Hadlick will have no difficulty with the legal constructions involved in our regulations, he might have some criticisms or suggestions dealing with the form of a particular regulation or with the language employed, and in such cases, we would appreciate his frank comments.

In order that Mr. Hadlick may handle his contacts with us expeditiously, I am attaching a list of the personnel, together with telephone extensions numbers. I sincerely trust that he will avail himself of any help these gentlemen may be able to extend to him.

Address—Office of Price Administration
Federal Office Building No. 1
3rd and D Streets, S. W.
Washington 25, D. C.
Telephone—Republic 7500

W. Page Keeton—Chief Counsel—Extension 72519
All questions involving legal construction in amendments and Orders. All questions involving legal interpretations of regulations.

Eugene D. Uman—Head, Refined Products Section—Extension 6636
All questions involving price of Refined Products, including liquefied petroleum gas.

John F. McCormack—Head, Crude Oil Section—Extension 73485
All questions regarding Crude Oil and Natural Gas.

Index of Week's War-Oil Orders

(Issued March 25 - April 1, 1944)

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OPA—Office of Price Administration
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SSR 22, Am. 1—Consumer services covered by SSR22
SSR26, Off. Corr.—Only bunker coal commissions covered
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WPB—War Production Board
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M-293, Table 2, Revocation—Relief from compliance with other WPB orders discontinued
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R-1, Appendix III as am. 3-22-44—400 tons balata released for unrestricted use

Digest of Week's War-Oil Orders

Petroleum Administration for War

SUPPLY & TRANSPORTATION COMMITTEE NOW GOVERNS DIST. 2 SUPPLY OPERATIONS—Petroleum Directive 65, as am. 3-15-44—Former Supply & Distribution Committee for Dist. 2 abolished. New Supply & Transportation Committee of 15 members will advise PAW on most efficient methods of transportation and of supply. Issued 3-15.

DEFERMENT RECOMMENDATION PROCEDURE—Telegraph Instructions to District Offices—PAW will endorse special deferment requests as to men under 26 years old engaged in 100-octane gasoline program. See 3-29 NPN, p. 3, for complete details. Issued 3-25.

Office of Price Administration

SERVICES TO WHICH REV. SR 11 DOES NOT APPLY—GMPR, Rev. Sr 11, Am. 45—Exempted services are: Common carriers' transportation of commodities; storage and warehousing by public utilities, which already have established rates; any other services when performed by public utilities. Notice of proposed increase in rates for such services must be

CODE: AO—Administrative Order; CMP—Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation; GO—General Order; Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order; PAO—Petroleum Administrative Order; Pri. Reg.—Priorities Regulation; Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

CMP 1, Direction 34 as am. 3-28-44—Class A facilities

ODT—Office of Defense Transportation
Rev. GO ODT 3, Am. 8—Submission of joint action plans

DSC—Defense Supplies Corporation
Rev. Reg. 1, Schedule "E", Am. 2—Supply terminals and supply areas

NWLB—National War Labor Board
GO 4, as am. 3-21-44—Exceptions to GO 4's Exemption

WMC—War Manpower Commission
GO 11—Revised list essential activities

Treasury Dept. (Bureau of Internal Revenue)
Treas. Decision 5343—Termination of certain exemptions from gasoline and lube oil taxes

OIL-LAW-Gram Service

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BLACKMER Rotary PUMPS

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War-Oil Compliance

filed 30 days before effective date with OPA Transportation & Public Utilities Division, Washington, as prescribed by Proc. Reg. 11. Issued and effective 3-24.

EQUIPMENT REPAIR CEILINGS—MPR 165, Am. 35—Maintenance, rental or repair of unit heaters or water heaters no longer excepted from coverage of MPR 165, and its maximum prices therefore apply. Issued 3-28, effective 4-3.

COVERAGE OF SUPP. SERV. REG. 22 ENLARGED—MPR 165, SSR 22, Am. 1—Gas unit heaters and water heaters no longer exempted from SSR 22's provisions. Repairers of such equipment using "customer's hourly rate" method of determining ceiling, or repairer having no employes subject to this regulation. Issued 3-28, effective 4-3.

ONLY BUNKER COAL COMMISSIONS COVERED BY SSR26—MPR 165, SSR26, Official Correction—Ceilings determined by SSR 26 apply only to commissions for bituminous coal sold for direct use as bunker fuel to foreign steamships. Issued and effective 3-29.

INSTALLED UNDERGROUND VESSELS EXEMPT FROM MPR 465's CONTROL—MPR 465, Am. 3—Issued 4-1, effective 4-7.

CONSUMERS' STOVE CERTIFICATES—RO 9A, Am. 7—Absolute requirement that only board in area in which stove is used may issue consumer certificate removed. Applications still made to that board, except for stoves for vehicles or boats, when application is made to board serving area in which conveyance is garaged, or, for good cause shown, to board of area where conveyance is located at time of application. Detailed instructions added as to transfer of stoves by U. S. agencies, dealers' borrowing of certificates from boards, transfers of stoves acquired under WPB priority order. Issued 3-23, effective 3-28.

PRIMARY SUPPLIERS' REPORT REQUIREMENTS SIMPLIFIED—Rev. RO 11, Am. 1—Revised OPA Form R-1119 is to be used for report due 4-25-44, segregating record of movement of stocks from ration evidence, and providing for listing of coupons outstanding on ration credit, as well as shortages of fuel oil or coupons due to losses, etc. Transfers between primary suppliers are to be scheduled on OPA Form R-1119A, and are forbidden unless each party furnishes his supplier registration numbers. Surrender of coupons for such transfers prohibited. Primary suppliers must now separate registrations of establishments within and without limitation area. Rules added governing reporting of three-way transactions in which dealers deliver fuel oil for another person's account. Form R-1119 also revised to show amount of fuel oil (unrationed) used by primary suppliers for experimental, laboratory research, etc. purposes. Receiver of an upstream transfer of fuel oil must give consumer a non-transferable ration check or exchange certificate, to be honored at board's discretion. Issued 3-27, effective 4-1.

War Production Board

RETREADING, RECAPPING, REPAIR EQUIPMENT—L-61, as am. 3-23-44—Only approved orders for new equipment valued at retail at over $85 may be filled. Orders for curing rings, spacer rings, full circle and sectional matrices must be approved, regardless of value. MRO orders and under-$85 orders come under CMP 5's provisions. Interchangeable facilities must be used to produce orders classified in the higher of the 10 groups of the production pattern table before filling orders in lower groups (15-day leeway permitted). Approved orders are those authorized by WPB under L-61 before 3-23-44, or those authorized, upon application, on Form WPB-1319. Issued 3-23.

GLASS CONTAINER AND CLOSURE RESTRICTIONS—L-103-b, as am. 3-23-44—Amendments apply largely to manufacturers and jobbers of containers, and to food, drug, and home packers. Uses of unauthorized sizes manufactured before 1-4-44 clarified, as well as quota free uses and "borrowed" uses within quota. Issued 3-23.

LUBRICATION EQUIPMENT RESTRICTIONS—L-314, as am. 3-24-44—Restrictions extended on use of metals and alloys. Equipment not permitted to be manufactured includes: metal-shielded grease and oil barrel

pumps, metal-shielded portable grease pumps and transfers, with some exceptions, metallic wall batteries, metal-shielded waste oil drains, oil bars, among other equipment. Completion of equipment from parts fabricated before 3-24-44 constituting at least 80% of finished equipment permitted. Schedules A through E, which were never given an effective date, deleted. Issued 3-24.

RELIEF FROM COMPLIANCE WITH SPECIFIED WPB ORDERS REVOKED—M-293, Table 2 revoked 3-24-44.

SAFETY AND TECHNICAL EQUIPMENT—M-293, Table 10—All types of high pressure carbon dioxide fire extinguishers now use shipping schedule Form 3003 and all such schedules are frozen for two calendar months. Issued 3-31.

400 TONS BALATA RELEASED FOR UNRESTRICTED USE—R-1, Appendix III as am. 3-22-44—Rubber Reserve Co. authorized to sell 400 tons miscellaneous grades of balata showing signs of deterioration to any person, without specific WPB authorization, for unrestricted consumption. All butyl type synthetics are now reclassified as "special purpose synthetics". Issued 3-22.

CLASS A FACILITIES—CMP 1, Direction 34 as am. 3-28-44—Making of a Class B facility for himself by a person not regularly engaged in manufacture of such facility, now governed, as to allotment of controlled materials, by same procedure as for making of Class A facility by such person, filing of WPB-541 (old PD-1A), etc., as set forth in Direction 34 to CMP 1, originally issued 10-4-43. But if person makes such facility in the normal course of his busines, CMP-4B application must be filed, as usual. Issued 3-28.

Office of Defense Transportation

SUBMISSION OF JOINT ACTION PLANS—Rev. GO ODT 3, Am. 8—Two or more common carriers may submit joint action plans to be effectuated by alternating, staggering, coordinating, suspending, exchanging, pooling schedules and shipments, and upon ODT's or ICC's approval may operate under such written plans. ODT Director of Motor Transport Division may direct two or more common carriers to formulate such plans or submit statement giving reasons for failure. Issued 3-25.

Defense Supplies Corporation

DSC SUPPLY TERMINALS AND AREAS—DSC Rev. Reg. 1, Schedule "E", Am. 2—List companies and counties deleted from or added to schedule, which include, among others, deletion of Richfield Oil Corp., Patchogue, N. Y. from Supply Terminal 25, deletion of entire Supply Area 30 (Staunton, Va.), as of 4-1-44, addition of American Oil Co. and Mexican Petroleum Corp. (Maine), of Providence, R. I., to Supply Terminal 11, addition of 13 counties to Supply Area 31 (Richmond, Va.), eff. 4-1, deletion of nine Virginia counties and addition of 3 to Supply Area 34, removal of Mifflin County, Pa. from Supply Area 63, and its addition to Supply Area 64. Issued 3-30.

National War Labor Board

EXCEPTION TO GO 4's EXEMPTION—Employers in Cuyahoga County, Ohio, engaged in repairing or rebuilding gasoline-operated motor vehicles or trailers, both bodies and chassis, for others, are not exempt from WLB's wage-raise approval requirement, even though employers of fewer than eight persons. Issued 3-21.

War Manpower Commission

GO 11—Revised List Essential Activities—No change from 2-25 list, except that reconditioning of certain containers, including metal drums, is added to list. Issued 3-25.

Treasury Department (Bureau of Internal Revenue)

GASOLINE AND LUBE OIL TAXES—Treas. Decision 5343—Sales of gasoline and lubricating oil to states, their political subdivisions, or to Federal government, no longer exempt from taxation. Approved 3-14, filed 3-15.

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1700 Teletyped Words that Served BOTH Oil Men and the Government

Last Monday—March 27—PAW telegraphed from Washington to its own offices, the new instructions for the oil industry getting deferment on its younger men. These instructions gave details as to how oil companies should immediately prepare deferment applications for their critical young technical men for consideration by the new draft deferment advisory committee of industries to WMC just appointed the Friday before.

These were some of the most important words ever sent out from Washington by any war agency because unless the industry can keep its critical technical men, PAW and the Rubber Director have frankly warned the production of 100 Octane aviation gasoline and of components for synthetic rubber for military purposes will be greatly reduced.

But in addition to the telegraph wires carrying this important 1700 word message to the 5 branch offices of PAW, at the same time Platt's OILGRAM, Daily Oil News Service, sent the same 1700 words out of its own Washington News Bureau on its own Teletype Service to three of its key OILGRAM production offices, New York, Cleveland and Tulsa, Oklahoma, so that in the first mail Tuesday morning the great bulk of Oilgram subscribers ALL OVER THE COUNTRY had the full text of this important message so that these oil companies could proceed AT ONCE and without an hour's delay, in preparing these papers for their critical technical men.

The immediate and accurate and comprehensive dispatch of vital operating information to OIL MANAGEMENT throughout the entire country, is a job OILGRAM has been doing for 11 years. This quick distribution of operating information, we have frequently been told, has been of great aid in the oil industry's speed in performing its war obligations.

Write for a two week's free trial of Platt's OILGRAM, Daily News Service. Address your communication to The W. C. Platt Company, 1213 West Third Street, Cleveland 13, Ohio.

OILGRAM—Daily News Service - $110 a year

Underground Tanks Removed From Pricing Regulations

NPN News Bureau

WASHINGTON — OPA March 31 removed from price control vessels which are installed underground at time of sale and which are purchased for use in their present location. Large majority of tanks affected are used for petroleum product storage.

OPA pointed out that PAW regulations require an outgoing supplier to sell his equipment to incoming suppliers but in such sale it is often very difficult, "if not impossible", to determine maximum price for buried vessel.

Oil marketers have long had set prices covering such transfers and these, OPA pointed out, are lower than maximum prices established by regulation MPR 465. In addition, under PAW rules, most companies will buy buried vessels as often as they sell them. In view of these facts OPA said exemption of sales from price control will not have an inflationary effect.

Action was taken in Amdt. 3 to MPR 465, effective on April 7.

OPA Increases 'Gas' Rations Of Farm Groups' Agents

NPN News Bureau

WASHINGTON — One step to increase "in-work" driving ceilings for those using automobiles in the course of their occupations was taken March 31 by OPA when it placed representatives of farm organizations in OPA's "essential" classification and made them eligible for preferred mileage under gasoline rationing rules.

After April 11, travel of these representatives, which was previously subject to the "B" ration ceiling, will be limited only by the mileage they need to carry out purposes of their organizations. These were listed as: (1) assisting farmers in increasing food production; (2) organizing or helping farmers' co-operatives; and (3) organizing or assisting farmers in co-operative use of farm livestock, machinery or equipment.

Persons eligible for this preferred mileage must be full-time paid employes, their organizations must be chartered by the U. S. or by a state, and must have a membership of at least 100 persons, the majority of whom are farmers.

Action was taken in Amdt. 116 to RO5C, effective April 11.

PAW To Revise Spacing Rules For Wells In 3 States

NPN News Bureau

WASHINGTON — Impending PAW revision of Supplementary Order 5 to PAO 11 will permit 10-acre spacing for all sand fields, regardless of depth, and 20-acre spacing for wells drilled to the McCloskey lime in the Illinois-Indiana-Kentucky basin.

Present terms of Supp. Order 5 allow 10-acre spacing for the same fields down to 2500 feet, and 20-acre spacing for sand fields below that depth, while PAO 11 itself requires 40-acre spacing for all limestone wells. Even under the revised order, however, maximum number of wells on a quarter section will be limited to four whether sand or lime.

Principal effect of relaxation is that it will permit considerable deepening of wells.

Kansas Jobbers Protest New OPA Rule on 'R' Coupons

Special to NPN

COLDWATER, Kansas—Two hundred jobbers from the Kansas area met with an OPA Washington representative at Wichita on March 20 to protest and submit alternate proposal to new Amd. 111 to Ration Order 5C which permits use of "R" gasoline coupons only at authorized filling stations, bulk plants and storage tanks on user's premises. Harry Spears, representing OPA at the meeting, which was sponsored by the Kansas Oil Men's Association, agreed to offer the proposal to Col. Bryan Houston, OPA deputy administrator for rationing.

Substitute plan suggests control of the black market through state gasoline tax exemption certificates which would provide check as to use made of gasoline allotted farmers, according to Jack Jacquiss, president of the Kansas oil men. Since there are only three states in the U.S., including Kansas, which use state tax exemption certificates, Mr. Jacquiss asserted, the plan could not be made national.

Jacquiss explained that jobbers in Kansas area feel the amendment would work a great hardship on them, since few of their bulk plants have facilities for loading small barrels used by the farmers and none of their stations or bulk plants have the transportation facilities to make their own deliveries.

Amendment 111 to Ration Order 5C becomes effective April 1.

OPA Increases April Quotas Of Truck, Tractor Tires

WASHINGTON—An increase in the number of tires to be rationed in April to small trucks and farm tractors and implements was announced March 29 by OPA in its release of tire rationing quotas for next month.

Comparison of March and April quotas follow:

April	Passenger & Motorcycle	March
691,525	New Tires	691,025
645,050	Used & Reclaimed	645,050
691,325	New Tubes	644,950
	Truck & Bus	
207,345	New Tires 7.50 Or Smaller	171,487
115,213	New Tires 8.25 Or Larger	114,311
230,407	New Tubes	230,503
	Farm Tractor & Implement	
13,800	Rear Tractor Tires	8,280
18,400	Front Tractor and Implement Tires	13,800
23,000	Tubes	18,400

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Have You and Your associates and employes who SHOULD know the War Regulations really read them yet?

Have You, the employer, discharged at least some of your duty to them by handing every one who SHOULD KNOW these new war rules, a copy of them? Have you said "Here, read, Study them, that you may be better able to protect yourself and our business, that you may better tell our customers—the general public—what they are expected to do in regard to using the gasoline and oil with care"?

You, and all associates and employes of YOURS, who may read this advertisement, are undoubtedly like all good American oil men—constantly in fear that some one in the company will slip up on some of these many rules and get you all into trouble.

Such ignorance and misunderstanding is no defense before the law, but it is quite human these days of thousands of war orders applying to oil alone, and which have to be carried out by a million or so people in the oil industry.

You, the company management, cannot buy guaranteed protection against excusable ignorance and natural misunderstanding, BUT you can protect yourself somewhat and give your equally anxious employes and associates "a break" by at least giving them a copy of each of the more important regulations with which they are concerned and which govern their daily acts FOR YOU.

TEAR OUT THIS PAGE AND MAIL IT BACK *NOW!*

Jot down the number of booklets you want on each of these Important War-Oil Regulations, in the space provided therefor beside each Booklet description. . . Then sign your name and fill in your address on the coupon below and mail this sheet back TODAY for immediate delivery!—Send no money—we'll bill you later.

Pick Out the Booklets That Cover Your Business

No. Needed

____BOOKLET 1—Prices on Fuel Oil, Gasoline, Liquefied Petroleum Gas and Solvents. Known as "Maximum Price Regulation 88." 90 pages. Single Copy Price $1.00. Quantity Rates: 2 to 5—90c, 6 to 10—80c, 11 to 25—70c, 26 to 50—60c, 51 to 100—50c, 101 to 250—45c, 251 to 500—40c, 501 and over—30c.

____BOOKLET 2—Latest revision of Retail Price Order on Motor Fuel, Motor Lubricating Oil, Greases, Kerosene, Prime White Distillate, Nos. 1 and 2 Fuel Oil, Range Oil and Naphthas. Known as "Revised Maximum Price Regulation 137." 20 pages. Rates: Single Copies to 5—50c, 6 to 10—45c, 11 to 25—40c, 26 to 50—35c, 51 to 100—30c, 101 to 250—28c, 251 to 500—25c, 501 and over—23c.

____BOOKLET 3—Crude Petroleum and Natural Gas Prices, including the 10 Amendments. Known as "Maximum Price Regulation 436." 24 pages. Single Copies to 5—50c, 6 to 10—45c, 11 to 25—40c, 26 to 50—35c, 51 to 100—30c, 101 to 250—28c, 251 to 500—25c, 501 and over—23c.

____BOOKLET 4—Bulk ceiling prices for Motor Oils, including Aviation Oils, Stock Oils (neutrals, bright stocks, steam refined and other stock oils), Greases, Industrial Oils, Petroleum Sulphonates, Mineral Oil Polymers, and any other fraction of crude petroleum which is sold as a source of any of the foregoing commodities. Known as "Maximum Price Regulation 510." 24 pages. Single Copies to 5—50c, 6 to 10—45c, 11 to 25—40c, 26 to 50—35c, 51 to 100—30c, 101 to 250—28c, 251 to 500—25c, 501 and over—23c.

____BOOKLET 5—Gasoline Rationing, including Am. No. 114, known as "Ration Order 5C." 204 pages. Single Copy $1.00. Quantity Rates: 2 to 5—90c, 6 to 10—85c, 11 to 25—80c, 26 to 50—70c, 51 to 100—60c, 101 to 250—50c, 251 to 500—45c, 501 and over—40c.

____BOOKLET 6—Fuel Oil Rationing, including all 95 amendments and omitting the obsolete material. Known as "Revised Ration Order No. 11." 175 pages. Single Copy $1.25. Quantity Rates: 2 to 5—$1.15, 6 to 10—$1.00, 11 to 25—90c, 26 to 50—85c, 51 to 100—80c, 101 to 250—70c, 251 to 500—60c, 501 and over—50c.

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WAR-OIL COMMUNICATION SERVICES

P.I.W.C. Sponsors Campaign to Instruct Public on 'Gas' Saving

NPN News Bureau

NEW YORK — The petroleum industry's gasoline conservation campaign, in co-operation with certain government agencies, was launched April 1. The campaign is directed by the Petroleum Industry War Council's Committee on Product Conservation, of which B. I. Graves of the Tide Water Associated Oil Co., is chairman, and W. W. Wells, secretary. Brochures explaining the drive have been sent to the presidents, sales managers, advertising managers and public relation directors of all marketing companies, and to their advertising agencies. These brochures are suggestions for copy, layout and radio programs, to be used in any way the companies see fit.

A new slogan, "Gasoline Powers the Attack—Don't Waste a Drop", has been released for the nationwide drive to acquaint the public, through the industry, with the need for conserving gasoline and all other petroleum products. The new slogan will be carried in all announcements by the OWI and the Committee on Product Conservation is urging all companies to include it in their advertising and radio commercial programs.

So far no plans have been made to carry the campaign down to the jobber level, but the committee expects that may be attempted later.

Campaign Aims Stated

The brochure sent the companies by the Committee on Product Conservation is an elaborately prepared exposition of the campaign. It states the aims of the campaign: "The petroleum industry has been requested by the governmental agencies involved—PAW, OWI, OPA and ODT—to co-operate with them in sponsoring a nationwide campaign to

"Get the public to conserve the use of gasoline by telling them the facts regarding the present serious gasoline situation.

"Eliminate the black market existing in certain areas in gasoline rationing coupons.

"Share use of automobiles to save gasoline, tires and for the maintenance of automobiles."

For conducting the drive the committee has taken permanent offices in Room 1630 at 50 West 50th St., New York City, and has set up sub-committees in all PAW districts.

Committee Secretary Wells last week conferred with subcommittee officials in Chicago.

° ° °

Dist. 2 Group Gives Plan Tentative O.K.

NPN News Bureau

CHICAGO—Dist. 2 products conservation subcommittee indicated its approval of the advertising campaign emphasizing gasoline conservation and share the ride and hitting at the black market as proposed by the P.I.W.C. committee on conservation in a 70-page brochure containing suggested copy.

The campaign was outlined by W. W. Wells, secretary, PIWC products conservation committee, at a meeting with the Dist. 2 subcommittee at industry headquarters here March 31, and will be presented for further discussion at meetings of the Dist. 2 marketing and general committees on April 25-26.

Subcommittee meeting last week was also attended by several oil company advertising managers and representatives of those departments, who were told that Deputy PAW Davies urges the oil industry to co-operate in the running of at least three joint advertisements in a manner similar to the "Low down on gasoline rationing" advertisement sponsored by Dist. 2 last September. That advertisement carried the names of 66 oil companies operating in the Middle West.

It is not anticipated however, that specific copy for these new joint advertisements applicable to Dist. 2 can be worked out, approved and financed co-operatively, plus securing of necessary newspaper space for the first display before June,

This poster symbolizes P.I.W.C.'s advertising campaign to conserve gasoline

with the two additional ones to be run in July and August, and those possibilities are only tentative. Steps taken at the subcommittee meeting were preliminary. Representatives were present from Standard of Indiana, Pure Oil, Skelly, Ohio Standard, Globe, Johnson Oil Refining, Sovereign Service and Phillips with others unable to attend calling for information as result of having just received the P.I.W.C. booklet sent to them by mail.

In detailing the proposed campaign, it was stressed by Mr. Wells that the entire matter was on a voluntary basis and that companies desiring to do so may begin using the copy designed for individual company use immediately, and the industry representatives present indicated their agreement to do so subject to official company approval. Plan is to insert the slogan, "Gasoline powers the attack—don't waste a drop," in all copy coming up immediately with the additional copy being worked in as conditions permit.

Theme of the copy it is expected will later be developed in mats for distribution by oil companies to their bulk plants and jobbers for use in local newspapers.

The nation-wide campaign will also be supported by movie shorts designed to reach 80 million people through picture houses. Eight articles prepared by OWI are due to break soon in national magazines. Question of obtaining industry support in the advertising campaign by insertion of slogan and other copy theme in department store advertisement and advertisements of other industries has also been discussed, it was stated at the meeting here, but turned down for the reason that it might delay starting of the program, but it is anticipated that that will follow since many industries besides oil have used the slogan "Oil is Ammunition—Use It Wisely."

Oil Fire Prevention Saved Million in Dist. 1, Dodge Says

NPN News Bureau

WASHINGTON — PAW April 3 announced that war-inspired alertness among oil workers and operators along the Atlantic Coast during 1943 has resulted in an estimated $1,000,000 saving in fire losses.

Dist. 1 Director Dodge said this represented an approximate 75% reduction from the annual peacetime average fire loss for this part of the industry, and that it had been accomplished in a year during which the nation's total industrial fire losses increased by nearly 50%.

"It is a remarkable tribute," said Mr. Dodge, "to the truly patriotic vigilance exercised by petroleum employes and management alike.

"While the Dist. 1 (east coast) figures refer to operations only in the 17 eastern states, they reflect the whole industry's sense of alertness. Undoubtedly, when nation-wide 1943 figures have been compiled, the petroleum industry will stand high in this national industrial honor roll."

In addition to activities of the individual managements and employes, Mr. Dodge credited the fire savings to the work of the Petroleum Industry War Council's committee on protection of petroleum facilities and, particularly, in Dist. 1 to its northeastern and southeastern regional committees; to the service commands in charge of plant security for the Army; to the Coast Guard for its protective surveillance of waterfront terminals; and to the PAW district division of facility security, of which Frank A. Epps is director.

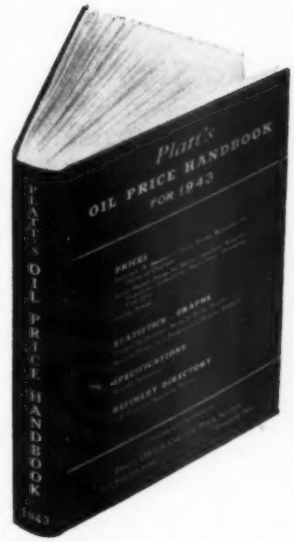
During the last year, 600 plant inspections were made by representatives of his division, both unaccompanied and jointly with representatives of the armed forces. More than 2700 written recommendations were made to the industry, as well as many additional oral recommendations. Mr. Dodge said:

"As an indication of the petroleum industry's interest and extreme willingness to co-operate, nearly 85% of these recommendations have been made effective," he continued.

"The net result has been a reduction of fire loss to $327,800 compared with the recent annual average loss for the oil industry in Dist. 1 of $1,300,000. During the year there were 11 fires in all properties covered by the program and two other cases involving no fire damage, but including injury and loss of life.

"Behind this accomplishment has been an intensive and voluntary training program undertaken by industry itself.

"However, the tangible results have been proved by the past year's figures and by the important fact that, to our knowledge, no delays from fire or sabotage were encountered in the manufacture or movement of any petroleum products to the armed forces in this district."



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- **Prices for any particular product for any day during 1943 with the "high" and "low" quotations, and monthly averages**

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PAW's Tank Redistribution Program Ready to Go; Stock Pile Assembled for Those Who Sign Up

NPN News Bureau

CHICAGO—PAW redistribution program No. 2 now has an inventory of 4,778 surplus metal tanks ranging in size from 65 to 1000 gal., which may be purchased by oil companies, oil jobbers and others in the petroleum industry who have subscribed to the redistribution plan. The tanks are not for sale to tank manufacturers, used tank dealers or junk dealers.

All of the tanks are now owned by oil companies and are surplus equipment, mostly in the marketing branch suitable for farm installations. Other oil companies and oil jobbers who are in need of such equipment—and it is much in demand—may obtain it by writing to L. B. Holland, Petroleum Administration for War, Dist. 2 director of materials, 624 S. Michigan Blvd., Chicago 5, who is in charge of the equipment inventory, provided they meet the requirements.

First requirement is that they subscribe to the redistribution plan by signing and sending in a certificate certifying that they are acquainted with the provisions of PAW materials redistribution program No. 2 and have filed or will file all necessary reports; that is, furnish lists of surplus equipment they have on hand from time to time.

For instance, if a jobber has on hand one or a dozen 65-gal. tanks and does not need them, he lists them as surplus equipment on PAW Form MA-3A and they are made a part of the PAW surplus equipment inventory subject to purchase by some other jobber who does need them. The first jobber then has the privilege of buying tanks of the size he needs from the inventory pool. If a jobber or oil company head has no surplus tanks on hand, he can still join the pool by sending in the certification that he will comply in event he later does have them, then go ahead immediately and buy what he needs from the pool.

All PAW forms needed for these transactions including an explanatory statement of the plan can be had by writing the materials department of PAW office in Chicago or any of the other four PAW district offices. After necessary requirements have been met, the PAW office will send the jobber the name and address of the oil company owning a tank or tanks of the size he wants to buy and providing the shortest transportation haul.

A similar inventory of surplus pipe, valves, casing, wire rope, electric motors, pumping units—all kinds of equipment used in producing, pipelining, refining and distributing petroleum and its products—is included in the redistribution plan and may be obtained in a similar manner.

Inventory of surplus tanks in the PAW Dist. 2 pool for redistribution, showing the sizes and states in which they are located, is shown in table below.

Californian Is Named to Post In PAW Materials Division

WASHINGTON—Appointment of William C. Brooks as special assistant to the director of materials division, succeeding Alvin Zwerneman, was announced this week by PAW.

As special assistant, Mr. Brooks will be in charge of the CMP-4B section of the materials division, which is responsible for allotments of controlled materials to the more than 400 petroleum equipment manufacturers who report to PAW as their claimant agency and industry division.

For past four years, Mr. Brooks has been assistant to the president of Petroleum Equipment Co. of Los Angeles. Before that he was employed for 23 years by California Standard, rising from an oil field laborer after World War I to purchasing agent of Los Angeles district.

Zwerneman returns to Axelson Manufacturing Co. to resume duties as vice-president.

Coming Meetings

APRIL

Natural Gasoline Assn. of America, annual meeting, Baker Hotel, Dallas, Wed.-Fri., April 12-14.

American Petroleum Institute, Eastern Division, Div. of Production, Deshler-Wallick Hotel, Columbus, Ohio, Thurs.-Fri., April 13-14.

Kentucky Petroleum Marketers Assn., annual meeting, Phoenix Hotel, Lexington, Ky., Wed.-Thurs., April 19-20.

Michigan Petroleum Assn., annual convention, Detroit-Leland Hotel, Detroit, Mich., Tues.-Wed., April 25-26.

National Council of Independent Petroleum Assns., executive committee meeting, Hotel Sherman, Chicago, Ill., Wed.-Thurs., April 26-27.

Independent Petroleum Assn. of America, board of directors' mid-year meeting, Emery Hotel, Bradford, Pa., Thurs.-Sat., April 27-29.

MAY

American Petroleum Institute, Mid-Continent Dist., annual spring meeting, Mayo Hotel, Tulsa, Okla., Thurs.-Fri., May 25-26.

JUNE

American Petroleum Institute, Southwestern District, spring meeting, Rice Hotel, Houston, Tex., Tues.-Wed., June 13-14.

Inventory of Surplus Farm Tanks Available in Dist. 2

STATE	NUMBER OF GALLONS															
	65 Gal.	90	110	120	125	150	190	200	210	220	225	250	275	280	285
Illinois	54 Tanks		56	28	3	2					1			20	8
Ohio	12 Tanks		7	23		46	4	15					8	36	3
Michigan	90 Tanks		6	66	1									5	
Oklahoma	18 Tanks	2	1	26										92	
Indiana	33 Tanks		88	71		1		1				2		37	
Wisconsin	4 Tanks								1	1				8	1
Tennessee	29 Tanks			9										36	
Minnesota														6	
Nebraska				5											
Kentucky	3 Tanks		1	7		1								160	
Missouri	1 Tank		4	10										82	
Kansas	1 Tank		1												
Iowa			3	7										1	
Colorado															
Total No.	245 Tanks	2	167	252	4	50	4	16	1	1	1	2	8	483	12

STATE	NUMBER OF GALLONS											
	290 Gal.	300	320	325	330	340	350	550	750	860	1,000	
Illinois	1 Tank	2	1	1			1	161			33	
Ohio							4	356			163	
Michigan		3		1				193			110	
Oklahoma								283			17	
Indiana						2		187			71	
Wisconsin		2	1		1		7	197			50	
Tennessee								206			19	
Minnesota				1				155		1	90	
Nebraska								108	1		15	
Kentucky		4	1					245			19	
Missouri								457			5	
Kansas								195				
Iowa								115			16	
Colorado								9				
No. Dakota								19				
So. Dakota								1				
Total No. Tanks	1	11	3	3	1	2	12	2,887	1	1	608	Total No. Tanks 4,778.

Refinery Operations

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Potential Refining Capacity Week Ended Mar. 25	Daily Potential Refining Capacity Week Ended Mar. 18	Per Cent of Refining Capacity Reporting Week Ended Mar. 25	Per Cent of Refining Capacity Reporting Week Ended Mar. 18	Daily Average Crude Runs to Stills Week Ended Mar. 25	Daily Average Crude Runs to Stills Week Ended Mar. 18	Per Cent of Reporting Capacity Operated Week Ended Mar. 25	Per Cent of Reporting Capacity Operated Week Ended Mar. 18
Combined**	2,518	2,448	90.3	90.0	2,274	2,268	90.3	92.6
Appalachian (Dist. No. 1)	130	130	83.9	83.9	102	103	78.5	79.2
Appalachian (Dist. No. 2)	47	47	87.2	87.2	48	53	102.1	112.8
Ind., Ill., Ky.	824	824	85.2	85.2	763	769	92.6	93.3
Okla., Kans., Mo.	416	416	80.1	80.1	363	351	87.3	84.4
Rocky Mt. (Dist. No. 3)	8	8	26.9	26.9	10	10	125.0	125.0
Rocky Mt. (Dist. No. 4)	141	141	58.3	58.3	104	103	73.8	73.0
California	817	817	89.9	89.9	779	780	95.3	95.5
Total U. S.—B. of M. Basis	4,901	4,831	87.3	87.1	4,443	4,437	90.7	91.8
U. S.—B. of M. Basis March 27, 1943					3,721			

Districts	Gasoline Production at Refineries inc. Natural Blended Week Ended Mar. 25	Gasoline Production at Refineries inc. Natural Blended Week Ended Mar. 18	Stocks of Finished and Unfinished Gasoline Week Ended Mar. 25	Stocks of Finished and Unfinished Gasoline Week Ended Mar. 18	Total Stocks Gas Oil & Distillates Week Ended Mar. 25	Total Stocks Gas Oil & Distillates Week Ended Mar. 18	Total Stocks Residual Fuel Oil Week Ended Mar. 25	Total Stocks Residual Fuel Oil Week Ended Mar. 18
Combined**	6,468	6,806	38,074	37,080	14,151	14,416	15,954	15,316
Appalachian (Dist. No. 1)	287	281	2,022	2,012	1,046	1,051	221	200
Appalachian (Dist. No. 2)	126	153	1,068	1,268	348	349	125	147
Ind., Ill., Ky.	2,576	2,676	20,258	20,056	5,402	5,481	2,825	2,943
Okla., Kans., Mo.	1,284	1,158	8,333	8,187	1,548	1,562	1,211	1,256
Rocky Mt. (Dist. No. 3)	29	28	75	77	20	20	29	28
Rocky Mt. (Dist. No. 4)	311	288	2,135	2,100	363	355	527	511
California	2,087	2,003	15,322	15,405	8,434	8,574	30,684	30,609
Total U. S.—B. of M. Basis	13,168	13,393	87,287*	86,185	31,312	31,808	51,576	51,010
U. S.—B. of M. Basis March 27, 1943	10,198		94,511		31,675		68,039	

*Finished 76,094,000 bbl.; Unfinished 11,193,000 bbl.
**Includes East Coast, Inland Texas, Texas Gulf, Louisiana Gulf, and North Louisiana-Arkansas districts.
To compare with subsequent weeks, stocks as of March 18 are: Finished, 75,062,000 bbls.; Unfinished, 11,123,000 bbls.

U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED Mar. 25 Barrels (Daily Average)	WEEK ENDED Mar. 18 Barrels (Daily Average)
Oklahoma	329,500	329,400
Kansas	274,100	284,150
Nebraska	1,350	1,350
Texas	1,863,350	1,863,350
Louisiana	360,100	360,150
Arkansas	79,650	79,700
Mississippi	41,500	38,700
Illinois	216,450	207,700
Indiana	13,600	11,850
Alabama	50	25
Florida	50	50
Eastern (Ill., Ind. & Ky. excluded)	69,000	72,150
Kentucky	22,400	19,100
Michigan	50,950	53,750
Wyoming	91,350	94,500
Montana	20,800	20,800
Colorado	8,200	7,900
New Mexico	112,850	112,850
California	829,500	827,800
Total, U. S.	4,384,750	4,385,275

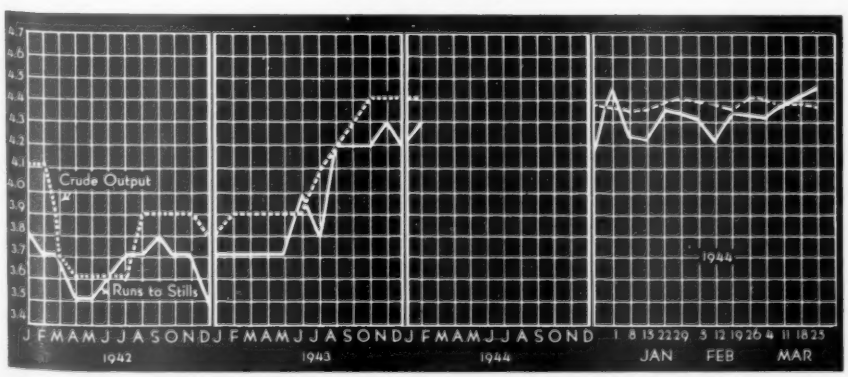
Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Mar. 25	Mar. 18	Change from Mar. 18
Penna. Grade	2,438	2,431	+ 7
Other Appalachian	1,368	1,361	+ 7
Lima-Michigan	958	1,037	— 79
Illinois-Indiana	13,940	13,394	+546
Arkansas	2,770	2,752	+ 18
Kansas	7,513	7,665	—152
Louisiana:	14,098	14,036	+ 62
Northern	3,628	3,656	— 28
Gulf Coast	10,470	10,380	+ 90
Mississippi	851	833	+ 18
New Mexico	7,045	7,182	—137
Oklahoma	32,667	32,682	— 15
Texas:	115,956	115,849	+107
East Texas	22,930	23,287	—357
West Texas	30,300	30,354	— 54
Gulf Texas	34,726	34,418	+308
Other Texas	28,000	27,790	+210
Panhandle	6,378	6,260	+118
North	5,565	5,439	+126
South	6,084	5,990	+ 94
Other	9,973	10,101	—128
Rocky Mountain	10,144	10,304	—160
California	34,944	25,438	—494
Foreign	1,593	1,155	+438
Total gasoline-bearing in U. S.	236,285	236,119	+166
Heavy in California	6,366	6,396	— 30

Crude Production & Runs to Stills

(Millions of Barrels)


Crude Output
Runs to Stills
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D 1 8 15 22 29 5 12 19 26 4 11 18 25
1942
1943
1944
JAN
FEB
MAR

N.P.N. Gasoline Index

	Dealer T.W. Cents Per Gal.	Tank Car Cents Per Gal.
April 3	10.51	6.65
Month ago	10.51	6.65
Year ago	10.33	6.69

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Pennsylvania Crude Runs

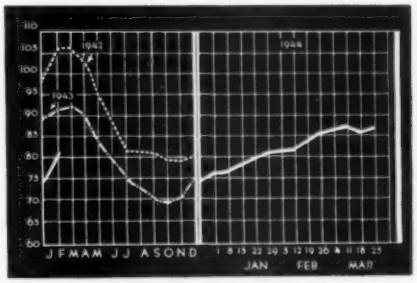
(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

DAILY AVERAGE

Week Ended Mar. 25, 1944	Week Ended Mar. 18 1944	Week Ended Mar. 27, 1943
68,791	66,772	82,824

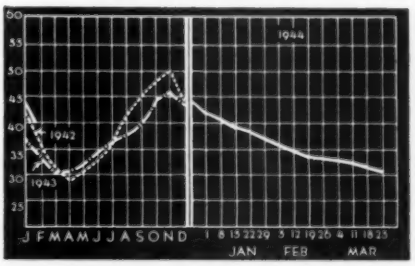
Gasoline Stocks

(Millions of Barrels)



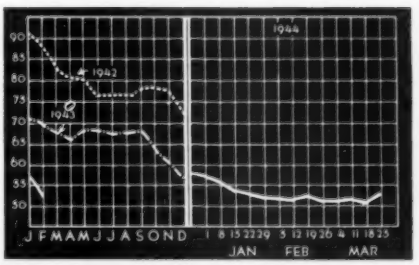
Gas Oil & Distillate Stocks

(Millions of Barrels)



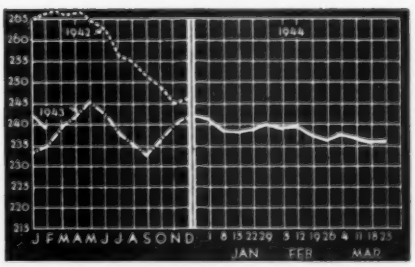
Residual Fuel Oil Stocks

(Millions of Barrels)



Crude Oil Stocks

(Millions of Barrels)



Market Reports

MIDWEST—Markets remained virtually unchanged the latter part of last week as colder weather brought increasing farm demand to a halt. Michigan and midwestern refiners expect to be able to handle first month of seasonal call for gasoline and tractor fuels without pro-rating supplies. Later months, however will find their storages completely dry with little possibility of filling them through inter-refinery purchase and, thus, force strict pro-ration of all products again, they say. No noticeable change yet felt in gasoline demand as result of cut in "A" card rations.

Providing Navy diesel fuel and substitution products at PAW's request has meant substantial cut in refiners' heating oil and tractor fuel production. Many also shipping large quantities of kerosine and range oil to East coast, meaning further reduction in heating oil storages. End-of-season demand is still absorbing what little is available.

No price changes reported.

° ° °

MIDCONTINENT — Persisting cold weather and rain holding off heavy agricultural call for gasoline and tractor fuel, refiners agree, but furnace oils and kerosine demand continues strong. Two Kansas refiners said they were completely out of No. 1 p.w. and kerosine and could not find any to buy. Burning oils demand is expected to taper off as soon as cold weather lets up, but brooding season will keep kerosine under heavy call all spring, refiner commented.

Texas refiner reported open spot sale of 25 cars 52 & below D. I. fuel at 3.875c for immediate shipment into Dist. 2.

Eight cars Grade 26-70 natural gasoline were reported sold at 4.75c f.o.b. Group 3. No open spot sales reported f.o.b. Breckenridge; sellers quoted 4.375c during the week.

° ° °

CALIFORNIA—All markets are reported firm. Gasoline, fuel oil, and butane, while selling for ceiling prices, are difficult to obtain. The usual differential between major company gasoline prices and independent prices are slowly disappearing. Some of the smaller refiners are still quoting one cent under major tank wagon prices but many are selling at straight major prices.

° ° °

ATLANTIC COAST—Stocks of light fuel oil steadily improving at North Atlantic points. Tank car shipments to East are still curtailed, but with warmer weather approaching, demands of consumers are beginning to slacken.

Available supplies of gasoline however, are now reported low and although present needs are being met, reports indicate that this product will become increasingly tight.

° ° °

GULF COAST — With military demands increasing, all refined products for civilian availablity become increasingly tight. Heavy calls for gasoline are being made by Eastern suppliers, but refiners at Gulf are unable to meet their demands. No price changes.

° ° °

PENNSYLVANIA — Western Penna. refiners reported all refined products very tight with inquiries heaviest for neutrals and bright stock. Three refiners said they were completely out of neutrals and could not find any to buy. Bright stock is no longer easily available in any part of Western Penna.

Industrial demand for fuel oils steady; 36-40 gravity fuel exceedingly hard to find. Lack of adequate transportation is causing shortages in some areas while scarcity of material is the cause in others. Greater portion of daily production of most refined products reported going for industrial and military needs. Stoddard solvent very tight and prices holding firm.

CRUDE PRICES

Since changes in crude oil prices are so few, the 2 pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

(*No changes reported during week ended Apr. 3. For latest tables of crude prices see NPN Mar. 29, pages* 54, 55.)

Summary of Daily Gasoline Prices (March 27 to April 3)

	Monday April 3	Friday Mar. 31	Thursday Mar. 30	Wednesday Mar. 29	Tuesday Mar. 28
U. S. Motor (ASTM octane)					
76 octane Ethyl:					
Oklahoma	6.75	6.75	6.75	6.75	6.75
Mid-Western (Group 3 basis)	6.75 – 7.25	6.75 – 7.25	6.75 – 7.25	6.75 – 7.25	6.75 – 7.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6.75 – 7 (2)	6.75 – 7 (2)	6.75 – 7 (2)	6.75 – 7 (2)	6.75 – 7 (2)
72 octane:					
Oklahoma	6	6	6	6	6
Mid-Western (Group 3 basis)	6	6	6	6	6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
63-66 octane:					
Oklahoma	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
Mid-Western (Group 3 basis)	5.6 – 5.625	5.6 – 5.625	5.6 – 5.625	5.6 – 5.625	5.6 – 5.625
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (1)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)
60 octane & below:					
Oklahoma	5.25	5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 72 octane (ASTM)					
New York harbor	9.2 – 9.4	9.2 – 9.4	9.2 – 9.4	9.2 – 9.4	9.2 – 9.4
New York harbor, barges	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3	9.1 – 9.3
Philadelphia district	9.2	9.2	9.2	9.2	9.2
Baltimore district	8.95	8.95	8.95	8.95	8.95
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.75 – 8.95	7.75 – 8.95	7.75 – 8.95	7.75 – 8.95	7.75 – 8.95
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.75 – 8.45	7.75 – 8.45	7.75 – 8.45	7.75–8.45(a)	7.75–8.45(a)

(a) Correct on and since March 1.

OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all NPN-OILGRAM offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

For complete price service delivered daily from nearest *OILGRAM* publishing office, New York, Cleveland and Tulsa, Okla. address Platt's *OILGRAM*, 1213 W. 3rd St., Cleveland (13), Ohio. Annual subscription rate payable in advance $100 a year via train mail and $125 per year via air mail.

Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified

Prices in Effect	April 3	Mar. 27
OKLAHOMA		
76 oct. Ethyl...	6.75	6.75
72 oct.....	6	6
63-66 oct.....	5.625(2)	5.625 (2)
60 oct. & below..	5.25	5.25
60-62, 400 e.p...	5.25 (1)	5.25 (1)
MID-WESTERN (Group 3 basis)		
76 oct. Ethyl...	6.75 – 7.25	6.75 – 7.25
72 oct.....	6	6
63-66 oct.....	5.6 – 5.625	5.6 – 5.625
60 oct. & below..	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl...	7	7
72 oct.....	6	6
63-66 oct.....	5.625 (1)	5.625 (1)
60 oct. & below..	5.2 – 5.25	5.2 – 5.25
60-62, 400 e.p...	5.375 (1)	5.375 (1)
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl...	6.75 – 7 (2)	6.75 – 7 (2)
72 oct.....	6	6
63-66 oct.....	5.75 (1)	5.75 (1)
60 oct. & below..	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
76 oct.....	7 (2)	7 (2)
72 oct.....	6 (2)	6 (2)
67-69 oct.....	....	....
62 oct & below..	5.25 (2)	5.25 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
60 oct. & below..	No Price	No Price
60-62, 400 e.p...	No Price	No Price
KANSAS (For Kansas destinations only)		
76 oct. Ethyl...	7.25 – 7.5 (2)	7.25 – 7.5(2)
72 oct.....	6.25 – 6.3	6.25 – 6.3
63-66 oct.....	5.9 (2)	5.9 (2)
60 oct. & below.	5.5	5.5
ARK. (For shipment to Ark. & La.)		
76 oct. Ethyl...	7 (1)	7 (1)
72 oct., leaded..	6 (1)	6 (1)
70-72 oct. "	5.875 (1)	5.875 (1)
62 oct. "	....	....
60 oct. & below, leaded.....	5.25 (1)	5.25 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.75 – 8.95	7.75 – 8.95
Other districts:		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.75 – 8.45	7.75 – 8.45

Prices in Effect	April 3	Mar. 27
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
72 oct.....	8 – 8.5	8 – 8.5
67-69 oct.....	....	....
Str. run gasoline, excluding Detroit shpt.....	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
72 oct.....	8.375	8.375
CALIFORNIA U.S. Motor:		
76 oct. (Ethyl)....	7.5 – 8.75	7.5 – 8.75
70-72 oct. (regular)	6.5 – 7.75	6.5 – 7.75
65 oct. & below (3rd grade).....	6.5 – 6.75	6.5 – 6.75

Kerosine, & Gas Fuel Oils

OKLAHOMA		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5	4.5
Range Oil.....	4	4
No. 1 P.W.....	3.875	3.875
No. 1 straw.....	....	....
No. 2 straw.....	3.625	3.625
No. 3 fuel.....	3.5 (2)	3.5 (2)
U. G. I. Gas Oil...	....	....
No. 6 fuel.....	....	....
14-16 fuel.....	$0.97 (2)	$0.97 (2)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5	4.5
Range Oil.....	4 –4.1 (2)	4 – 4.1(2)
No. 1 p.w.....	3.875	3.875
No. 2 straw.....	3.625	3.625
No. 3.....	....	....
No. 5.....	....	....
No. 6.....	$0.80 (1)	$0.80 (1)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w....	4.375	4.375
42-44 grav. w.w....	4.5 (1)	4.5 (1)
No. 1 P.W.....	3.875 (1)	3.875 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w...	4.5 (1)	4.5 (1)
No. 1 straw.....	No Price	No Price
KANSAS (For Kansas destinations only).		
41-43 grav. w.w...	No Price	No Price
42-44 grav. w.w...	4.7 – 4.75	4.7 – 4.75
No. 1 p.w.....	4.1	4.1
No. 6 fuel.....	$0.85	$0.85
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w...	....	....
42-44 w.w. kero...	4.5 (1)	4.5 (1)
No. 1.....	4 (1)	4 (1)
No. 2.....	3.625 (1)	3.625 (1)
No. 3 fuel.....	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only....	5.125 (1)	5.125 (1)
Diesel fuel 52 & below.....	4 (1)	4 (1)
Diesel fuel 58 & above.....	4.25 (1)	4.25 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.....	6.55 – 8.05	6.55 – 8.05
46 grav. w.w.....	6.675 (1)	6.675 (1)
No. 1 fuel.....	6.875– 8.05	6.875– 8.05
No. 2 "	6.75–7.625(2)	6.75–7.625 (2)
No. 3 "	6.75–7.75 (2)	6.75–7.75 (2)
36-40 gravity.....	6.625–6.75 (2)	6.625–6.75(2)
Other districts:		
45 grav. w.w.....	7.25 – 7.925	7.25 – 7.925
46 grav. w.w.....	7.25 – 7.625	7.25 – 7.625
47 grav. w.w.....	7.375– 7.875	7.375– 7.875
No. 1 fuel.....	6.875– 7.375	6.875– 7.375
No. 2 "	6.75 – 7.375	6.75 – 7.375
No. 3 "	6.75 – 7.375	6.75 – 7.375
36-40 grav. Pittsburgh dist. prices excluded.....	6.625– 7.375	6.625– 7.375
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate...	5.5	5.5
No. 3 gas oil, Straw	5	5
U.G.I. gas oil.....	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis....	....	....
100-300 Vis....	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine.....	7	7
CALIFORNIA		
40-43 grav. w.w...	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel.....	$1.10 (2)	$1.10 (2)
Light fuel.....	$1.20 (2)	$1.20 (2)
Diesel fuel.....	4 (2)	4 (2)
Stove dist.....	5 (2)	5 (2)

Prices in Effect	April 3	Mar. 27
Los Angeles:		
Heavy fuel.....	$1.10 (2)	$1.10 (2)
Light fuel.....	$1.20(2)	$1.20 (2)
Diesel fuel.....	4 (2)	4 (2)
Stove dist.....	5	5
San Francisco:		
Heavy fuel.....	$1.15 (1)	$1.15 (1)
Light fuel.....	$1.25 (1)	$1.20 (1)
Diesel fuel.....	4 (1)	4.5 (1)
Stove dist.....	5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	April 3	Mar. 27
WESTERN PENNA.		
Prices are for sales made, or offers reliably reported, to jobbers & compounders only.		
Viscous Neutrals—*No. 3 col. Vis. at* 70°*F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.....	35 (1)	35 (1)
10 p.t.....	34 (1)	34 (1)
15 p.t.....	33 (1)	33 (1)
25 p.t.....	28–32.5	28–32.5
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.....	33 (1)	33 (1)
10 p.t.....	32 (1)	32 (1)
15 p.t.....	31 (1)	31 (1)
25 p.t.....	26–30.5	26–30.5
Cylinder Stocks		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 8 col.*		
10 p.t.....	30.5 (1)	30.5 (1)
15 p.t.....	29.5 (1)	29.5 (1)
25 p.t.....	25	25
600 S.R. filterable.	15	15
650 S.R.....	15.5	15.5
600 fl.....	16	16
630 fl.....	17	17
MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. 0 to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2....	8	8
86-110—No. 2...	8.5	8.5
150—No. 3.....	14.5	14.5
180—No. 3.....	15	15
200—No. 3.....	15	15
250—No. 3.....	16–16.5	16–16.5
280—No. 3.....	17	17
300—No. 3.....	18	18
Red Oils:		
180—No. 5.....	15 (1)	15 (1)
200—No. 5.....	15 (1)	15 (1)
280—No. 5.....	No Price	No Price
300—No. 5.....	17.5 (2)	17.5 (2)

Note: Viscous Neutrals, 15-25 p.p. generally are quoted 0.5c under 0-10 p.p. oils. Non-viscous oils, 15-25 p.p.; generally are quoted 0.25c under 0-10 p.p. oils.

NOTE—Discounts of 1c for contracts and 1c and 2c and sometimes more off in addition, to "meet competition" are generally being allowed from these posted prices on "conventional" oils.

Bright Stock—*Vis. at* 210°		
200 Vis. D.....	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p.....	23	23
10 to 25 p.p.....	22.5–23	22.5–23
25 to 40 p.p.....	23 (1)	23 (1)
150-160 Vis. E....	22 (1)	22 (1)
120 Vis. D:		
0 to 10 p.p.....	22 (2)	22 (2)
600 S.R. Dark Green.....	8.5 (1)	8.5 (1)
600 S.R. Olive Green.....	10–11 (2)	10–11 (2)
631 S.R.....	....	....
Black Oil.....	5.5 (1)	5.5 (1)
SOUTH TEXAS Neutral Oils		
Pale Oils (*Vis. at* 100°*F.*)		
Vis. Color		
100 No. 1½-2½.	6.5	6.5
200 No. 2-3.....	8.75	8.75
300 No. 2-3.....	9.25	9.25
500 No. 2½-3½.	10	10
750 No. 3-4.....	10.25	10.25
1200 No. 3-4.....	10.375	10.375
2000 No. 4.....	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	April 3	Mar. 27
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude.)
Neutral oils *vis. at* 100° *F. 0 to 10 p. p.*

Pale Oils		
Vis. Color		
60-85—No. 2	9.5 (1)	9.5 (1)
86-110—No. 2	10 (1)	10 (1)
150—No. 3	15.5 (1)	15.5 (1)
180—No. 3	16 (1)	16 (1)
200—No. 3	16 (1)	16 (1)
250—No. 3	17 (1)	17 (1)
Red Oils:		
180—No. 5	16 (1)	16 (1)
200—No. 5	16 (1)	16 (1)
250—No. 5	17 (1)	17 (1)
280—No. 5	18 (1)	18 (1)
300—No. 5	18.5 (1)	18.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined: (*Viscosity at* 210°)

140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)

Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*

0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago, add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	4.75 (Sales)	4.75 (Sales)
FOB BRECKENRIDGE		
Grade 26-70	4.375 (Quote)	4.375 (Quote)

CALIFORNIA (FOB plants in Los Angeles basin)

21 pound vapor pressure for blending	4.75 – 5.375	4.75 – 5.375

Naphtha and Solvent

(*FOB Group* 3)

Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1 – 7.125	7.1 – 7.125
Mineral spirits	6.1 – 6.125	6.1 – 6.125
Rubber solvent	7.1 – 7.125	7.1 – 7.125
Lacquer diluent	7.375– 8.125	7.375– 8.125
Benzol Diluent	7.875– 8.625	7.875– 8.625
WESTERN PENNA.		
Bradford-Warren District:		
Stoddard Solvent	7.5 (1)	7.5 (1)
Other Districts:		
Untreated naphtha	7 – 7.25	7 – 7.25
Stoddard solvent	7.25 – 8	7.25 – 8

OHIO (S. O. quotations for statewide delivery): V.M.&P. naphtha, D.C. naphtha, Varnolene &

Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)

White Crude Scale:		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25

OKLAHOMA (C.L. FOB Refinery)

Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars 0.5c per lb. less.)

Snow White	6.125– 7.25	6.125– 7.25
Lily White	5.375– 6.25	5.375– 6.25
Cream White	4.375– 5.5	4.375– 5.5
Light Amber	3.375– 4	3.375– 4
Amber	3.125– 3.75	3.125– 3.75
Red	3 – 3.5	3 – 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include taxes;** *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect April 3, 1944 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J.

	Esso (*Regular Grade*) Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45	6.5	12.8
Charleston, W. Va.	12.25	12.75	6.5	13.6
Parkersburg, W. Va.	11.55	12.05	6.5	13.3
Wheeling, W. Va.	11.55	12.05	6.5	13.9
Charlotte, N. C.	12.1	12.6	7.5	11.6
Hickory, N. C.	12.65	13.15	7.5	12.6
Mt. Airy, N. C.	12.5	13.0	7.5	11.8
Raleigh, N. C.	11.85	12.35	7.5	12.6
Salisbury, N. C.	12.15	12.65	7.5	13.0
Charleston, S. C.	10.95	11.45	7.5	....
Columbia, S. C.	11.8	12.3	7.5	....
Spartanburg, S. C.	12.5	13.0	7.5	....

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	....	....	....
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	....
Richmond	10.3	9	9
Charlotte, N. C.	10.6	10.4	....
Hickory, N. C.	....	10	....
Raleigh	11.6	10.1	....
Charleston, S. C.	....	9	....
Columbia	....	10	....
Spartanburg	....	10.8	....

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphthas—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

(N.B. Prices are Continental's "structural" prices. Prices do not reflect temporary reductions made to meet local competition.)

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline, 1/2c on kerosine; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Mis. 1/50c; Neb. 3/100c; Nev. gasoline 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-z (*Reg*) †Tank Wagon	De-mand (*3rd Grade*)	Gasoline Taxes	Kerosine T.W.
Denver, Col.	11	10	5.5	11
Grand Junc., Col.	12.5	11.5	5.5	12.5
Pueblo, Col.	10.5	9.5	5.5	10.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	11	10	5.5	11.5
Billings, Mont.	12.5	11.5	6.5	12.5
Butte, Mont.	13.5	12.5	6.5	13.5
Great Falls, Mont.	12.5	11.5	6.5	12.5
Helena, Mont.	13	12	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	14.1	13.1	6.5	16.5
Twin Falls, Ida.	15.6	14.6	6.5	17
Albuquerque, N. M.	10	9	*7	9.5
Roswell, N. M.	9.5	8.5	*7	9
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9.5	9.25	*7	9.5
Texarkana, Ark.	9	8	*5.5	9
Muskogee, Okla.	9.5	8.5	7	8.5
Oklahoma City, Okla.	9.5	8.5	7	8.5
Tulsa, Okla.	9.5	8.5	7	8.5

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla. 5.5c state applies within city limits of Ft. Smith, Ark.

†To consumers & Dealers.

S. O. NEB.

	(*Regular Grade*) T.W.	Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4	9.6	6.5	10.1
McCook	12.0	10.1	6.5	10.5
Norfolk	11.9	10.4	6.5	10.6
North Platte	12.2	10.6	6.5	11
Scottsbluff	12.9	10.2	6.5	10.5

S. O. CAL.

	Standard Gasoline (*Regular Grade*) Posted Tank Truck	Posted Tank Truck	Flight Gasoline (*Third Grade*) Posted Net Tank Truck	Posted Tank Truck	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale & Commercial: T.C. deliveries 0.25c per gal. off posted net tank truck.

Commercial: Retail deliveries, and/or tank truck deliveries of less than 40 gals., 4c per gal. above posted net tank truck price for Standard Aviation and Standard Gasoline, and 3c per gal. above posted net tank truck for Flight Gasoline, except single deliveries of less than 40 gals. to Marine trade only, which are billed at posted net tank truck price.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices—Continued

S. O. IND.

Red Crown (*Regular Grade*)
Blue Crown (*Third Grade*)

Red Dealer Prices	Crown Cons. T.W.	Red Crown	Blue Crown	Gaso-line Taxes	Kero-sine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.6
Decatur, Ill.	11.6	9.6	8.7	4.5	10.3
Joliet, Ill.	11.9	10.3	9.2	4.5	10.6
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9.6	5.5	10.1
Evansville, Ind.	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5.5	10.5
Detroit, Mich.	11.4	9.9	9.4	4.5	10
Grand Rapids, Mich.	11.4	9.9	9.4	4.5	9.9
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul	11.9	10.4	9.9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11.0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10.9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	9.0

Stanavo Aviation 73 Octane
Withdrawn Jan. 1, 1944.

	Oleum Spirits	V.M.&P. Naphtha	Stani-sol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minnep'ls.	14.2	15.2	13.5	5.5

Fuel Oils T.W.
Chicago

	Standard Heater Oil
1-99 gals.	9.3
100-149 gals.	8.3
150-399 gals.	7.8

	Stanolex Furnace Oil
1-99 gals.	8.8
100-149 gals.	7.8
150-399 gals.	7.8
400 gals. & over	7.3

	Stanolex Fuel Oil A
1-99 gals.	8.3
100-399 gals.	7.3
400-749 gals.	6.3
750 gals. & over	5.55

	Stanolex Bunker C Fuel Oil
1-399 gals.	6.8
400-999 gals.	5.8
1000 gals. & over	4.8

Other Points	Stanolex Furnace Oil
Indianapolis	
1-99 gals.	9.0
100 gals. & over	8.0
Detroit	
1-99 gals.	8.7
100 gals. & over	7.7
Milwaukee	
1-99 gals.	9.0
100 gals. & over	8.0
Minneapolis	
1-99 gals.	9.1
100 gals. & over	8.1
St. Louis	
1-99 gals.	8.4
100 gals. & over	7.4
Kansas City	
1-99 gals.	8.1
100 gals. & over	7.1

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

HUMBLE OIL

Humble Motor Fuel (*Regular Grade*)

	Thriftane Humble *Tank Wagon	Thriftane Humble Re-tail	Thriftane (*Third Grade*) *Tank Wagon	Thriftane (*Third Grade*) Re-tail	Gaso-line Taxes
Dallas, Tex.	7.5	10.5	6.5	10.5	5.5
Ft. Worth, Tex	6.5	9.5	6	7.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

	Kerosine *Tank Wagon	Kerosine Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

73 Oct. Aviation Gasoline	Tank Car
FOB Baytown, Tex.	8.5

*To all classes of dealers & consumers.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher. Cleveland Division assumed the state-wide fuel oil tank wagon prices on Nos. 1, 2 and 3 fuel oil, effective May 10. However the price of 7.55c per gallon and No. 4 fuel oil (full compartment hose dumps only) will remain as heretofore, in Cleveland Division.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

S. O. OHIO

*Sohio X-70 Gasoline (*Regular Grade*)

	Con-sumer T.W.	**Re-sellers	Gaso-line ‡S.S. Taxes	†Kero-sine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Marietta	12	9.5	12.5	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio Aviation Gasoline clear Spec. AN-F-22	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	26.5	5.5

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	*7.55

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

3-Star Imperial Gasoline (*Regular Grade*)

	†Gasoline T.W.	*Gasoline Taxes	†Kero-sine T.W.
Hamilton, Ont.	17.5	11	18
Toronto, Ont.	17.5	11	18
Brandon, Man.	21	10	23
Winnipeg, Man.	20.5	10	22.5
Regina, Sask.	18	10	20
Saskatoon, Sask.	20.8	10	22.8
Edmonton, Alta.	18.9	10	20.9
Calgary, Alta.	16	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	17	11	17.5
St. John, N. B.	16.5	13	19
Halifax, N. S.	16.5	13	19

*Includes 3c Federal, and Provincial taxes. To divided & undivided dealers.

ATLANTIC REFINING

Atlantic White Flash (*Regular Grade*)

	Commercial T.W.	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.7	11.2	5.5	12.6
Allentown	10.7	11.2	5.5	12.6
Erie	10.7	11.2	5.5	12.6
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.7	11.2	5.5	12.6
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.7	11.2	5.5	12.6
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	5.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn.	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	....	11.55	7.5	11.9
Brunswick, Ga.	....	10.4	7.5	11.1
Jacksonville, Fla.	....	10.4	8.5	12.1

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

Fuel Oils—T.W.

	1	2	3	5	6*
Phila., Pa.	10.1	9	9	5.76	5.04*
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9	9	....	....

‡Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.
Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

*Residual fuel 13.0-15.9 gravity effective 10/17/43.

S. O. KY.

Crown Gasoline (*Regular*)
Standard (*Third Grade*)

	†Net Crown	Dealer Standard	Gaso-line Taxes	Kero-sine T.W.
Covington, Ky.	9.5	...	6.5	9.3
Lexington, Ky.	10.5	...	6.5	9.3
Louisville, Ky.	10	...	6.5	8.8
Paducah, Ky.	10	...	6.5	8.8
Jackson, Miss.	10	...	7.5	*9
Vicksburg, Miss.	9.5	...	7.5	*8.5
Birmingham, Ala.	10	...	*8.5	9
Mobile, Ala.	9	...	*9.5	9.5
Montgomery, Ala.	10	...	*9.5	10
Atlanta, Ga.	11.4	...	7.5	*12.1
Augusta, Ga.	11.4	...	7.5	*11.6
Macon, Ga.	11.4	...	7.5	12.1
Savannah, Ga.	10.4	...	7.5	11.1
Jacksonville, Fla.	10.4	...	8.5	10.1
Miami, Fla.	10.4	...	8.5	10.1
Pensacola, Fla.	9	8	*9.5	8
Tampa, Fla.	10.4	...	8.5	10.1

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, not included in above prices.

†Consumer t.w. prices are same as net dealer prices.

S. O. LA.

Esso Gasoline (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	10.5	11	8.5	12.5
Memphis, Tenn.	8.90	9.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax
Discounts:

Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

(Continued on next page)

Seaboard Export Coastwise Prices

Atlantic Coast (Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect April 3.

MOTOR GASOLINE

District	72 Oct. (ASTM)	68-70 Oct. (ASTM)	KEROSINE and/or NO. 1 FUEL
N. Y. Harb.	9.2 – 9.4	9.2 (1)	7.1
N. Y. Harb., barges	9.1 – 9.3	9.1 (1)	7
Albany	9.3 – 9.5	....	7.3
Philadelphia	9.2	....	7.2
Baltimore	8.95	8.85 (1)	7.2
Norfolk	8.7 – 8.95	8.5 (1)	7.1
Wilmington, N. C.	8.7 – 8.75	8.5 (1)	7.05
Charleston	8.7 – 8.8	8.1 (1)	7.2
Savannah	8.25 – 8.4	....	7.05
Jacksonville	8.27 – 8.4	....	7.05 (1)
Miami	8.27 (1)	....	7.05 (2)
Tampa	8.27 – 8.4	8.275 (1)	7.05
Pensacola	7 – 7.2 (1)	....	4.8 (1)
Mobile	7 – 7.2	....	4.75 (2)
New Orleans	6.125– 6.75	....	4.25 – 4.75
Portland	9.5 – 9.65	....	7.3
Boston	9.4 – 9.7	9.7 (1)	7.2
Providence	9.4 – 9.7	....	7.2

FUEL OILS

District	No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	6.7	6.7	$1.95–$2.01 (a)	$1.65 –$2.07
N. Y. Harb., barges	6.6	6.6	....	....
Albany	6.8	6.8 (2)	....	$1.85–$2.27 (1)
Philadelphia	6.7	6.7	$1.98	$1.65 –$2.07
Baltimore	6.7	6.7	....	$1.65 –$2.07
Norfolk	6.7	6.7 (1)	....	$1.65–$2.07 (2)
Charleston	6.7	....	....	....
Savannah	6.7 (2)	....	....	$1.60–$2.02 (2)
Jacksonville	....	....	....	$1.60–$2.02 (1)
Miami	6.25	....	....	$1.60–$2.02 (1)
Tampa	....	....	....	....
Pensacola	6.25 (2)	....	....	$1.50–$1.92 (2)
Mobile	....	....	....	....
New Orleans	3.75 (2)	....	$1.27 (1)	$0.85–$1.27 (2)
Portland	6.8	6.8 (2)	....	$1.65–$2.07 (1)
Boston	6.7	6.7 (2)	$1.95–$2.07 (1)	$1.65 –$2.07
Providence	7.2	6.7 (2)	$1.90 (1)	$1.65 –$2.07

(a) This price is for straight-run low pour test No. 5 fuel.

Pacific Export *In Ship's Bunkers, or deep tank lots:*

Prices in Effect	April 3	Mar. 27
Diesel Fuel, Pac. Spec. 200	$1.45	$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

Tank Wagon Prices (Continued)

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Indiv. Dlr. T.W.	Gasoline Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	10.2	10.7	5.5
Jamestown, N. Y.	10.4	10.9	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	4.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	...	7.1	9.0
Albany	7.5	9.8	7	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.6	10.9	8	10.3	8.2	10
Jamestown	8.7	11	...	10.6	8.3	10
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.2	8.8
Danbury	8.2	10.8	...	....	7.5	8.8
Hartford	8.0	10.5	...	9.5	7.2	9
New Haven	7.8	10.3	...	9.3	7	8.9
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	7	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.9	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	....	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.6	9.9	6.9	9.2	7.1	8.9
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
N. Y. Harbor	$1.65 –$2.07	$2.78	6.7–6.8 (2)	6.8 (2)
Albany	$1.85 (1)	$2.98 (1)	7 (1)	6.7
Philadelphia	$1.65 –$2.07	$2.78	....	....
Baltimore	$1.65 –$1.89	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.65 –$2.07	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.60 –$2.02	$2.78 (2)	6.7 (1)	6.7 (1)
Savannah	$1.65 –$1.89	$2.62 (1)	....	....
Jacksonville	$1.60–$2.02 (2)	$2.62 (2)	....	....
Tampa	$1.50 –$1.92	$2.62 (2)	....	....
New Orleans	$0.97 –$1.09	$1.65 (1)	4 (1)	....
Portland	$1.65 –$1.89	$2.86 (2)	7 (1)	6.9 (1)
Boston	$1.65 –$1.89	$2.78	6.7 (2)	6.8 (2)
Providence	$1.65 –$2.07	$2.78 (2)	6.9 (1)	6.8 (1)

Residual fuel prices generally vary with A.P.I. specifications from range low for 9.9 & below degrees to range high for 25.0 & above.

Gulf Coast

Prices in Effect April 3

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barge	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
76 oct.	6.75	6.5 – 6.75	6.75	6.75	6.75
72 oct.	6.125	5.75	5.75	5.75	5.75
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.75
67-68 oct.	....	....	....	....	5.5
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125–4.25	4.125	4.125– 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	....	4
53-57 di.	4.125	4.125	4.125	4.125	4.125
58 and above	4.25	4.25	4.25	....	4.25

HEAVY FUELS & BUNKER OILS In Cargoes (At all Gulf Ports) Heavy Diesels	In Ship's Bunkers (Ex-lighterage)
Below 28 API Grav.	$1.35
28 & above API Grav.	$1.65
Bunker C Oil... $0.85–$1.27	$0.85–$1.27

Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

NOTE—Prices for heavy fuels vary within the range given above according to gravity from 9.9 B grav. and below to 25 B and above.

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals)

Prices in Effect April 3

	Steel Drums	Bulk
200 Vis. D 210 brt. stock	35 (1)	28.8 (1)
150 vis. D 210 brt. stock 0-10 p.p.	31 (1)	24.8 (1)
10-25 p.p.	....	....
100 vis. D 210 brt. stock 0-10 p.p.	....	....
10-25 p.p.	....	....
200 vis. No. 3 col. neutral: 0-10 p.p.	....	....

Wax

(Melting points are AMP, 3° higher than EMP. Prices are FOB refinery and do not include bag, freight or export differentials).

Prices In Effect April 3

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25(1)	....	4.25(1)
122-4 White.	....	4.25(2)	4.25(2)
124-6 White.	4.25(1)	4.25	4.25
Fully Refined:			
123-5	5.2(1)	5.2(2)	5.2(1)
125-7	5.2(1)	5.2(2)	5.2(1)
128-30	5.6(1)	5.6	5.6(1)
130-32	5.85(1)	5.85(2)	5.85(1)
133-5	6.15(1)	6.15	6.15(1)
135-7	6.4(1)	6.4(1)	6.4(1)

Naphtha

Prices In Effect April 3

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia dist.	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

WAR-OIL EQUIPMENT EXCHANGE

If You Can't Use It, Sell It or Scrap It!

For Sale

FOR SALE

4350-gallon, three compartment 1940 Fruehauf semi-trailer three inch lines. 1940 Gotfredson tractor with Cummins Diesel motor. Excellent shape. 10.00/20 tires all around. Westinghouse air brakes. Outfit in use every day.

Box No. 360

FOR SALE

Fairbanks Morse Diesel Generator Set, complete with controls and control board. Engine Model 42E 8¾, 2 cylinder, 60 H.P., 450 RPM. Generator belt driven 1200 RPM, 49.5 K.V.A. 3 phase, 60 cycle. Excellent condition. Price $4500.00.

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ABOUT OIL PEOPLE

E. H. Wiet, division manager and manager of natural gasoline sales for Skelly Oil Co., was elected president of Tulsa Rotary Club at a recent meeting and will take office July 1, to serve for a year. Mr. Wiet is now treasurer and a member of the board, and has been the secretary and vice president of the organization.

° ° °

C. E. Heyns has been appointed acting Director of Marketing for PAW Dist. 5. Ernie Heyns, as he is better known, replaces **Charles B. Garretson** who resigned to organize a joint working staff for the Dist. No. 5 Distribution and Transportation committee. For the past two years Mr. Heyns has been assistant to Mr. Garretson. Prior to joining PAW he had wide experience in the marketing field, being connected with Richfield Oil Corp. for 17 years.

° ° °

Maj. Raymond C. Gunther has been appointed officer-in-charge of the refrigeration school in the Quartermaster Replacement Training Center at Camp Lee, Va. In civilian life he was a special engineering and refrigeration consultant and an advisor on lubrication system design to industrial machinery manufacturers. At one time he was connected with the Socony-Vacuum Oil Co.

D. R. Donlen, The Texas Co., Chicago, has been appointed chairman of the Dist. 2 asphalt subcommittee, succeeding **E. W. Miles,** Indiana Standard, resigned. Mr. Miles will continue as a member of the subcommittee.

° ° °

Shell Refinery Gets National Security Award

J. O. St. Armant, right, president of the Norco Employes Labor Council, accepts the National Security Award, in ceremonies held at Shell Oil Co.'s Norco refinery March 17. The award, established by the Office of Civilian Defense, and given in recognition of the firm's contribution to the war effort, was presented by R. E. Smith, center, director of the Eighth Regional Office, OCD. W. B. Stewart, left, manager of the refinery, also joined in the acceptance. Alexander Fraser, Shell president, was a speaker, recalling that Shell had pioneered in the production of aviation gasoline in Louisiana

Appointment of **C. D. Winkelman** as superintendent of the Texas-Gulf area of the Shell Pipe Line Co. has been announced by **H. H. Anderson,** company vice president.

Mr. Anderson also announced that the Bayou Pipe Line System which extends from Texas refineries to Baton Rouge, La., will be administered as a division of the Texas-Gulf area. **S. B. Bean** has been appointed superintendent of the Bayou division with headquarters at Port Neches.

C. P. Wilson, who has been Baytown terminal supervisor of the Bayou system since November, 1942, has been named foreman of the Baytown district with immediate supervision over a pipeline operation and maintenance activities in Texas west of the Trinity River.

Other changes in Bayou system senior personnel include: **W. H. Astley,** Bayou office manager at Houston; **L. J. Rittiner,** former system engineer transferred to head office engineering to handle technological problems and former chief clerk **H. W. Sanborn** has been moved to head office accounting. **W. H. Craddock,** former superintendent of the Louisiana division has become division superintendent of Shell's Midcontinent area with headquarters at Healdton, Okla.

° ° °

Fred Morris, formerly division geologist of Cities Service Oil Co. has been named manager of the southern division of the company with headquarters in Houston. He replaces **D. L. Connelly,** who resigned to go with Warren Petroleum Corp. **H. Ben Cox** has been named division land man in Houston. He formerly was assistant superintendent of the company's land department at Bartlesville, Okla.

° ° °

Otto W. Bender has been named transportation officer of the tank car section of the New York Office of Defense Transportation to succeed **Charles R. McCarthy,** who has been transferred to Washington. Announcement was made by **Raymond A. Greene,** regional manager of ODT's Division of Petroleum and Other Liquid Transport. Mr. Bender comes to ODT after 14 years with the Chicago & Northwestern Railroad. Previous connections include two years with the Pennsylvania Railroad, five years with the Long Island Railroad, and four years with the New York Central Revision Bureau.

° ° °

Joseph H. Bennis was elected president of the New York and New Jersey Lubricant Co., New York, at a directors' meeting March 17. Mr. Bennis, who has been associated with the company since its organization in 1896 and head of its sales department for more than 30 years, succeeds **W. F. Kimball.**

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When Does a Gas Pump Become a Service Station?

IN PAW directives, a service station is defined as *"any place of business or part thereof where motor fuel normally is sold and delivered into the fuel supply tanks of motor vehicles."*

Perhaps this definition suffices for purposes of PAW directives. But it won't do for us because it fails to recognize the most important element of service station operation—the human element.

To us a service station has come to mean much more than just a gas pump. It means a man in business, earning a living for himself and family by leading a life of service to others. It means a man doing a lot of favors for friend and stranger alike; inflating tires, filling radiators, checking batteries, cleaning windshields, lending a wrench, and giving road directions.

Today, these station operators find it difficult to maintain their normal standards of service because of manpower shortages and wartime sales restrictions. But a successful service station exemplifies the SPIRIT OF SERVICE. It is just plain common sense to keep that spirit alive even in the face of almost insurmountable difficulties.

That is why, under wartime dislocations, Fleet-Wing, in supporting its jobbers and their dealers, continues to make every effort to personalize relationships between station servicemen and their customers.

TECHNOLOGY DEPT.

NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to

REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

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DETROIT

Section Two

April 5, 1944

An extensive live steam smothering system provides additional fire protection for the toluene extraction plant of the Richmond refinery of Standard Oil Co. of California. The toluene unit has more than 75 of these steam lines, most of them manually controlled, opening into confined areas where there is a possible fire hazard. The lines vary from 1½ to 2 inches in diameter and carry live steam under 125 pounds pressure.

The steam lines shown in the picture serve the debutanizer reboiler furnace and two still reboiler furnaces. A still reboiler furnace is shown on the right, with overhead transfer lines carrying vaporized stock from the furnace to the still on the extreme left.

Toluene made at this extraction unit of Standard of California, as at other units over the country, is now being used as a blending agent for aviation gasoline. The plants were built by the oil companies to make toluene for the manufacture of explosives. So completely has this wartime need been supplied that the toluene output of most plants has now been switched to use in the manufacture of aviation gasoline

Making Ready to Process West Texas "Sour" Crude

Program of Preparation of Large Oil Company Started with Inspections and Cost Estimates to Determine First If It Is Practicable to Run High Sulfur Crude in Existing Installations (See p. R-185)

He Enhanced Automotive Engine Performance

Thomas Midgley Jr. . . .

EQUALLY ACCREDITED among petroleum and automotive technologists is Thomas Midgley, Jr., president for 1944 of the American Chemical Society, which is holding its 107th meeting in Cleveland April 3-7. His discovery of tetraethyl lead as an antiknock compound in fuel for internal combustion engines profoundly affected the development of gasoline power by paving the way for high compression engines. Not only was more efficient automotive transportation made possible for the driving public in the past two decades, but also a basic factor was established for the development of aviation.

Following his discovery of Ethyl fluid, Dr. Midgley became vice president of the Ethyl Gasoline Corp., now the Ethyl Corp., in 1924. A corollary to his development of tetraethyl lead was his work in the recovery from seawater of bromine used in making the lead compound. He also discovered the use of organic fluorine compounds as safe refrigerants. Dr. Midgley is the recipient of many honors bestowed by chemical societies. He is a native of Beaver Falls, Pa., and received his engineering degree from Cornell University.

REFINERY MANAGEMENT *and*
PETROLEUM CHEMICAL TECHNOLOGY

April 5, 1944
Volume 36
Number 14

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How to Prepare for 'Sour' Crude Processing

Midcontinent Refiner Gives Benefit of Experience to Others Contemplating Plant Changes Necessary to Treat Crude of High Sulfur Content; Exhaustive Survey Was First Step in Company's Plan and Proved Useful Guide

THE preparations made by a representative refiner for handling West Texas high-sulfur crude to supplement the supply of sweet crude normally handled in his plant started many months before the actual change is scheduled to take place.

This preparatory work is supplying the data on which changes in equipment and methods for running the new type of oil will be based. It also provides estimates of costs which will enable the company to determine whether the "sour" crude can be profitably processed in the existing plant, or whether it would be more practicable over a period of years to install completely new units for certain stages of the processing.

The preparations include:

1—Thorough inspection of all existing equipment to determine its probable life under the contemplated operating conditions.

2—Recommendations by the engineering department as to what individual items of equipment should be repaired, given special protection against the anticipated increased corrosion rate, or replaced entirely; together with the cost of these changes.

3—Study of the most practical means for treating, storing and processing the new type of crude with the least interruption to routine operations.

In its present program this particular refiner has the benefit of earlier experience, since it handled in the past some sulfur crude in its plant, which was originally designed for non-corrosive crudes. Accordingly, its program has been more comprehensive than possibly might be the case with companies without such experience. Its program of preparation is described here in detail, to aid other refiners now facing the problem of deciding whether to handle the sour crudes.

The historical background of this refinery where it is now proposed to run the corrosive West Texas crude is not unlike that of many plants, particularly in the Midcontinent area. It is a topping and cracking unit of approximately 10,000 b/d throughput capacity.

The original plant was built of carbon steel throughout, with the intention of operating it exclusively on Midcontinent low-sulfur crudes. A flow diagram of the pipe still is shown in Fig. 1. Later, as process changes and technological advances dictated higher temperatures and pressures, certain equipment was constructed with alloy steels to better withstand these more rigorous conditions.

Still later, the company began to run a limited volume of crudes which were higher in sulfur than the type of crude for which the plant was originally designed. As equipment began to fail from corrosion, due to both hydrogen sulfide and hydrochloric acid, additional alloy protection was added from time to time.

The early experience acquired in running a limited volume of "sour" crudes convinced company officials that certain prime requisites must be fulfilled for satisfactory operations on a larger scale with high-sulfur crudes. Briefly these included:

1—Since the sour crude considered as the most likely source for this refinery contains considerable salt as well as sulfur, and must be desalted, sufficient ammonia must be injected to neutralize the hydrogen chloride formed from the magnesium chloride remaining in the desalted stock. Experience indicated it is cheaper to use ammonia injection than to protect condensers and other equipment with corrosion-resistant alloys.

2—For tower linings, 11-13% CrMo alloy steel should be used, rather than the 4-6% CrMo alloy. The service life of the 4-6% chrome material does not justify its cost for lining purposes, this refiner believes. Freedom from down-time losses, occasioned by the use of 11-13 alloy, will more than justify the cost differential between it and the 4-6 alloy, in his experience.

3—Sour and sweet crudes should be run separately so that aviation naphthas and distillate fuels can be made from the sweet crude. Corresponding fractions from high sulfur crude are best suited for cracker and reformer feeds.

4—Cracking feeds should be blends of sweet and sour stocks to avoid high-sulfur concentrations. In this manner alloys containing less chrome can be used than if the sour stocks are run straight. Consideration should be given to starting each run on sweet stock to form a protective layer of coke on the cracking coils, which will serve as additional "insulation" against sulfur corrosion.

5—For pipe still and cracking coil tubes and headers, as well as exchanger bundles and transfer lines, 4-6 CrMo alloy steel should be installed at all points where the temperature exceeds 600 deg. F. Where vessels such as exchangers will be subjected to temperatures higher than 600°F., they should be lined with 11-13 CrMo alloy. Sheets and heads should be similarly lined or replaced with 4-6 CrMo alloy.

Inspection is First Step

Until sufficient experience with sour crude is gained by the individual plant, it is desirable to inspect equipment far more frequently and thoroughly than is customary when operating exclusively on sweet crude. Such inspections will indicate where to look for trouble. As a result of the individual peculiarities of various plants, it may be found desirable to extend alloy protection at points below the 600°F.-temperature range. Also, in many cases it will be desirable to retain some old piping as long as it will last under the more severe conditions before replacing with alloy. It will take careful inspection to know when the limit of safety has been reached.

In the particular plant under discussion, the engineers recommended that no changes be made in equipment unless it is subjected to temperatures above 600°F. Even in some towers where carbon steel trays and bubble-caps are installed, it was proposed to leave them in place until their maximum service life has been attained. Then they will be replaced with 4-6 CrMo alloy trays and enameled bubble-caps and stacks.

When the running of sour crude in the wartime program of this refiner was contemplated, the first step in the preparation was an inspection of the entire prop-

erty to see just what equipment would have to be repaired or replaced and what entirely new equipment would have to be installed. Replacements and repairs incident to normal plant operations of course were noted in the course of the inspection but recommendations in such instances have been omitted here, limiting the discussion to the changes required to handle sour crude. The inspection procedure followed is standard practice by refineries generally. For simplicity, that portion of the plant involved in changes incident to sour crude refining has been divided into four sections: pipe stills and auxiliaries, cracking stills and auxiliaries, gas plant, and tankage.

It was decided that 4-6 CrMo should be used for all tubes and headers at temperatures above 600°F. in the pipe still furnace. Inspection revealed that 33 carbon steel tubes ranging from 28 ft. to 30 ft. 4 in. in length, and 33 carbon steel headers would have to be replaced. In addition, 31 CrMo tubes already in the furnace will require replacement because of the header renewals. These tubes will be salvaged in so far as possible through butt-welding and to this extent the number of new tubes required will be reduced.

Most of the fractionator towers in the crude topping unit require repairs not incident to sour crude operation; all contain some 4-6 CrMo lining. Because much of the lining needs repair, the whole probably will be replaced with 11-13 CrMo for reasons previously discussed. One tower, however, requires 1535 sq. ft. of this alloy to make it corrosion resistant, because all of this now unlined portion is in the 600°F.-plus temperature zone. Although bubble-caps and trays now are cast iron, they will be left alone as long as they function, then replaced with enameled cast iron caps and alloy trays. All nozzles and manholes will be relined with the 11-13 CrMo alloy. A reflux drum requires the unprotected bottom head to be lined with about 65 sq. ft. of 11-13 chrome.

All tower lines and fittings subjected to above 600 deg. F. temperatures are to be 4-6 alloy or alloy-lined. Similarly, all pumps not equipped with corrosion-resistant liquid-ends will have ni-resist liners, durable valves and 18-8 stainless or metallized rods installed. Stainless steel instrument taps are to be provided where corrosion temperature indicates, and continuous pH recorders are recommended for two of the towers to control ammonia injection.

Safety requirements involve provision for canister-type masks for personnel working in the danger area, installation of fans in pump rooms to assure adequate ventilation, a partition for the pump room to put the control panel in a separate enclosure and isolation of crude charge pumps.

New equipment items recommended include a crude desalter and a caustic wash system for the naphtha and gas oil sidestreams. A Petreco electric desalter is to be installed, complete with a pump to supply the desalter with crude at desired pressure and to deliver desalted crude to the preheat train ahead of the pipe still.

The light crude naphtha will be stabilized to remove H_2S along with the light ends, eliminating any need for caustic scrubbing of this stream. Two 400 E.P. naphtha streams and two 400-600 gas-oil streams will require caustic washing with a total of 10,000 lb. of 10% caustic daily to remove H_2S. Two alternatives have been set up to meet this requirement:

In one, a 10% caustic solution would be injected directly into the sidestreams ahead of the cooling worms to allow intimate mixing of the alkali with the naphtha, for H_2S scrubbing. Spent caustic will flow into rundown pans, from whence it will be discarded to the sewers. One or two 2500-gal drums and a pump supplying one gpm solution will supply caustic through branched discharge lines equipped with control valves. Drums could be pressured with air to avoid pumping and this is being considered. Caustic will be mixed in batches.

The other alternative method of caustic washing envisions the installation of two 8 x 12 ft. drums, one to handle the combined naphthas and the other the gas-oils. Both will be half full of caustic and contain sufficient ring packing to give good contact between product and caustic;

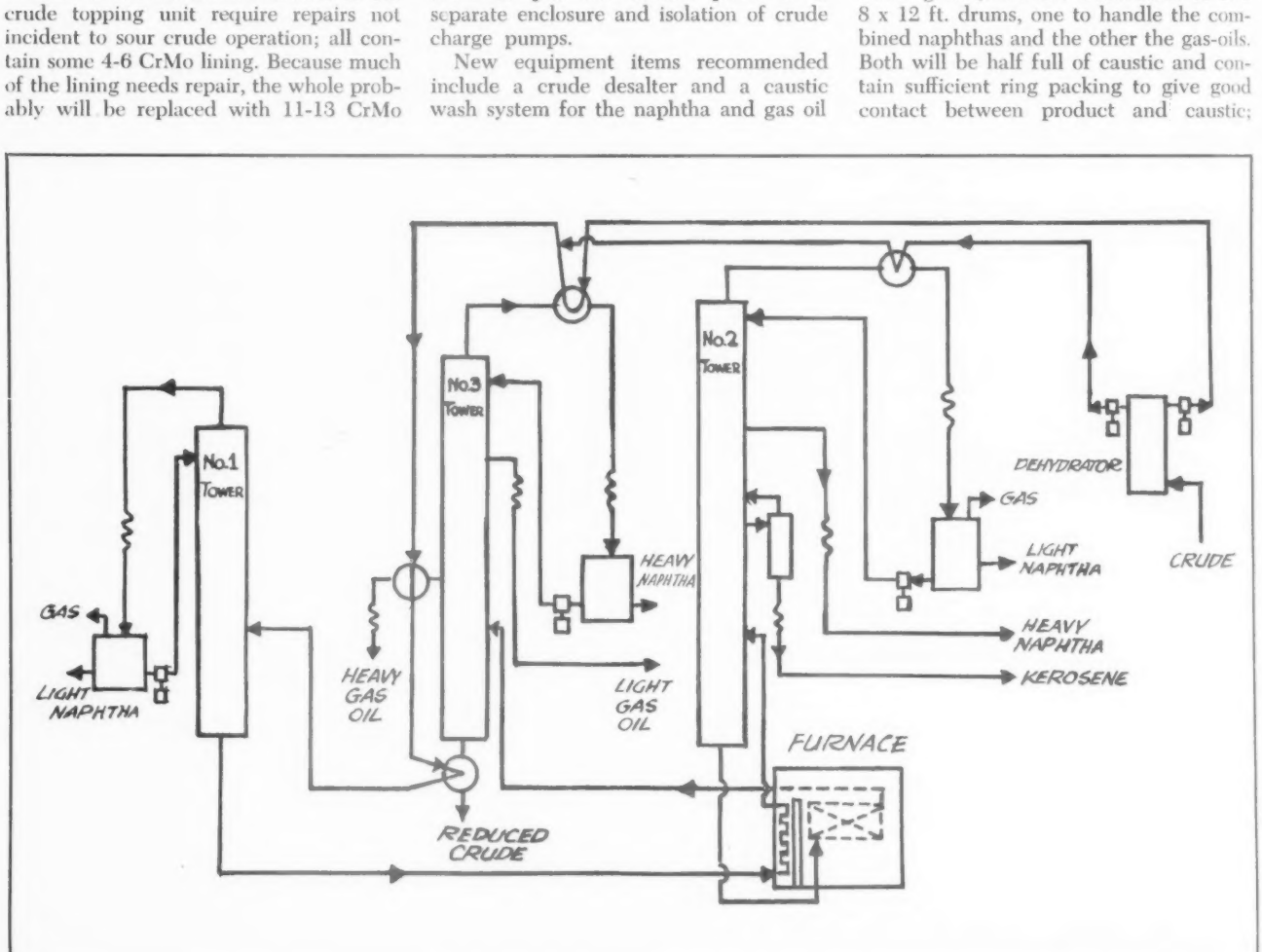

Fig. 1—Pipe still flow diagram of refinery preparing to run sour West Texas crude

the upper half of each will serve as a settler. Distribution of product from the towers will be with spiders in the bottom of the drums. The drums will be supplied with fresh caustic in batches and the spent caustic will be pumped in batches to caustic disposal ponds.

Cracking Unit

Some alloy tubes already were installed in the cracking furnace, which is divided into liquid and vapor phase sections. However, forty-six 4-6 CrMo alloy tubes, 4½ in. O.D. by 31 ft. long must be supplied to replace non-corrosion resistant tubes. Some 14 additional tubes must be replaced solely because header boxes to which they are connected must be renewed with alloy steel. A total of 48 header boxes, now of carbon molybdenum alloy steel, will be replaced with the 4-6 alloy; 62 others, now equipped with 4-6 CrMo bends, will be made corrosion resistant by welding an alloy bead between the seat and tube-end to fill up the gap of unprotected metal which will be subject to corrosive conditions.

Furnace jumpover lines and steam-out connection piping, including valves and fittings, must be protected with chrome alloy.

The engineering department's recommendatioins include relining a 10 x 40 ft. separator drum with 16 gauge 11-13 CrMo (1200 sq. ft.) including manholes, shells, nozzles, and heads; disc-and-doughnut trays are to be of 11-13 alloy, also tray supports, spill-pan, and internal piping. A combination bubble-tower, now alloy lined, will have all cast-iron trays replaced with alloy when their service life is reached; bubble caps and stacks, numbering approximately 1000, will be replaced with enameled cast iron caps and stacks. Chrome angles will be substituted for cast iron originals.

Heat exchangers will be alloy-protected on the vapor side only. Present floating heads will be replaced with 4-6 CrMo alloy. Some tubes (all alloy) will be replaced because it would be mechanically difficult to reroll them, as a result of external corrosion. All lines and fittings handling products at temperatures in excess of 600 deg. F. will be replaced or lined with alloy. Tar cooler coils operating above corrosion temperature will be similarly protected, and this also applies to all pumps not now protected. Alloy nipples for taps will be installed for all instrument and gauge lines where temperature indicates.

Safety requirements include furnishing adequate pump room ventilation, gas masks for personnel working in danger areas, and alloy test plugs for inspection.

Gas Plant

A 60-ft. absorber tower in the gas plant now is partially protected with a chrome alloy liner; the remaining portion, while now corroded to some extent, still has from 5/64 to 4/32 in. corrosion allowance. Operating on "sweet" stocks would require lining the unprotected area in 1—1½ years. The inspector postulated two alternatives for this condition when sour crude is handled: (1) leave tower alone and determine new corrosion rate, or (2) line the unprotected portion. The first alternative was recommended because of extensive changes already contemplated in the plant.

The primary still of the gas plant now is partially corroded. The portion most severely corroded will be lined with 11-13 CrMo and lining of the lower half done later, it is planned. The stabilizer tower will have to be completely lined with alloy. However, this stabilizer requires other extensive repairs normal to its operation regardless of the type of crude to be processed in the future. For this reason it may be discarded as scrap and a new one (or a good second-hand one) used as a replacement.

Protection of Tankage

The inspection department made the following recommendations for crude storage:

"A. Crude storage: It seems evident that it is necessary to provide protection to prevent formation of iron sulfide on unwetted shells and roofs of tanks. This may be done either by installing a spray system of small lines with a small pump taking suction on the crude tanks themselves, or tying the tanks together with balance lines, providing a closed system, and excluding all air from tankage so that iron sulfide cannot form.

"The difficulty with this closed system is in getting the tanks airtight, providing the necessarily large balance lines, providing for the 'breathing in and out' when pumping . . . . and securing automatic or outside gauging devices. The difficulty with the installation of the spray system is its installation, securing the small pumps or one large pump for all tanks needing the spray system, and the possible liberation of H_2S and SO_2 into the atmosphere. It is felt, however, that the spray system would be less expensive. Another alternative would be to use a sealing material and coat roof, rafters, and shell in vapor area.

"B. Cracking feed stock storage; sour crude still gas-oil: (a) Keep storage to a minimum and (b) exclude air, provide connection to relieve vacuum, and H_2S scrubber and/or flare to burn same, or gunite-line entire tank, or use a sealing material.

"C. Rundown pans; coke still gas-oil: Three pans will need protection; try sealing materials.

"D. Piping: Any changes to tankage will require piping changes. However, steel pipe and fittings or cast iron fittings should suffice.

"E. Safety: Masks for all personnel who might be exposed to H_2S; automatic or remote gauging devices; safety gates on stairways; post adequate warning signs."

A further recommendation is that at least two men be present during sampling, one to be on the ground while the other does the work.

Behind the Bylines In this Issue

Arthur Fox Holler has been active in engineering design and construction work connected with the petroleum industry for over two decades—ever since he joined the Caribbean Engineering & Construction Corp. in the British West Indies in 1922. With Standard Oil Co. of Pennsylvania since 1928, he is now their superintendent of construction and maintenance. He recently had charge of construction of all buildings on the Pennsylvania Turnpike (except Turnpike Commission maintenance buildings).

Mr. Holler

World War I interrupted his education, but he returned to Lafayette College after serving in the U. S. Navy and received his B.S. in Civil Engineering in 1921. Mr. Holler's contribution to this issue starts on p. R-240, "Revivification of 'B' Foam Solution for Wet Foam Fire Extinguishing Systems".

L. W. McLennan, who writes about "Barium Grease" in this issue p. R-234), for the past 13 of his 16 years with the Union Oil Co. of California has been associated with research on lubricants and greases. He collaborated in the early laboratory experimental development work on barium greases, and thus became familiar with their special properties and uses.

Mr. McLennan

Although born in Canada, Mr. McLennan moved around widely to obtain his education, received at schools and universities not only in his native country but also in England and the States, and is now a U. S. citizen. At present he's engaged in further work designed to extend the manufacture and application of this new type of grease.

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Inquiries for reprints in quantities of articles appearing in NPN's Technical Section should be forwarded promptly after receipt of the issue, by telegram if possible. Present conditions make it impossible to hold the type in the forms after the issue has been published and reprints ordered after the type has been broken down have to carry the additional cost of resetting the article.

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Petroleum Solvent Naphthas

Varied New War Uses for This Type of Specialty Petroleum Product Point to Wider Applications in the Post-War Days

The extensive use of petroleum solvents in protective surface coatings began soon after the last war and has seen great development in the course of the present conflict. Many other applications have also been found for the solvents of the closely controlled range of boiling points and the degree of purity supplied by the oil industry today.

Postwar uses for petroleum solvents may include some of the highly branched isoparaffins because they confer a higher viscosity on resin and rubber solutions and also possibly the individual aromatics boiling above toluene which contribute to the durability of coatings in which they are used.

By E. H. McArdle*

SOLVENTS come under the head of added expense to their users in most industries. Unhappily, civilized man cannot get along without something to thin his paints, varnishes, enamels, lacquers, inks, oils, fats, waxes, pitches, adhesives and textile saturants so that they will brush, spray, dip, print, spread, penetrate or flow out properly. Since there is usually no handy means of recovering the vapors, it is only sound business to conclude that the less money wasted on solvents the better.

Cheapest actual solvents for these materials are straight-run petroleum naphthas. They cost about as much as ordinary motor fuel, the gasoline tax being balanced by charges to solvents for better fractionation, more stringent refining, carefully segregated handling and storage, and higher shipping rates. Next cheapest solvents are such petroleum fractions as the aromatic concentrates and superfractionated normal paraffins, which, after the war, will probably be supplemented by the highly branched isoparaffins and pure aromatics.

When its use is made possible, ordinary drinking water is the cheapest thinner of all and, accordingly, the paint and varnish industry has already changed formulas in one of its major products so that water will thin it. Oil-base interior architectural paints which are "devoid of objectionable solvent odors" and which smell only faintly unless made with fish oil, have recently achieved a permanent market acceptance. Successful oil-base area-paints are also formulated with a water external phase. Next step may be to use water in prepared outside house paint, which during the current drying-oil shortage contains a third, instead of the usual 10%, of petroleum thinner. It appears possible to render a water-thinned house paint rain-resistant within a comparatively short time after suitable application.

If successful in water-thinning all

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types of architectural paints, the formulator might naturally consider the application of water to industrial coatings. Here, such problems as obtaining the optimum rate, or best relative rates, of solvent release, together with film uniformity and surface adhesion will be more difficult to meet with water dispersions. Thus our present proven types of single phase vehicles—wherein the resinous, cellulosic or rubbery polymer is molecularly dispersed—will doubtless continue to serve for an indefinite period.

Competition

Cheap as they are, it is safe to say that petroleum naphthas will never entirely replace higher cost solvents which do the same job. A master painter who would admit that vehicle and pigment are the primary controlling factors in the quality of a house-paint, and that therefore the "turps"—at 30 cents a gallon in peacetime—could well be replaced by the 12-cent "mineral spirits", would, to say the least, be departing from tradition. Meanwhile, less conscientious house painters in other countries accept mineral spirits after a few per cent of "turps" has conferred that "right" smell.

Odor is indeed a powerful influence in the choice of a solvent. In the dry-cleaning industry, for example, large quantities of high cost, less easily recoverable, and relatively corrosive chlorinated solvents are used in preference to mineral spirits not only because they are less inflammable but mainly because the last traces of solvent odor are more easily removed from clothing. Similarly, during the early days of aromatic petroleum naphthas, their "petroleum" odor necessitated a lower selling price than that of otherwise strictly competitive coal tar naphthas.

A straight-run and SO_2-extracted petroleum aromatic, which was doctor-sweet and lower in both sulfur and olefin content, nevertheless exhibited a sufficiently "different" odor to invite objections from operators who were thoroughly accustomed to the smell of coal tar solvents of the same volatility and aromatic content. As a newcomer to the solvent business, petroleum has been wrong until it has proved itself right. This, despite the fact that properly refined petroleum solvents nearly always have the milder odor. This is admirably shown by the only odor-comparing device, the "osmoscope" of Anderson-Prichard Refining Corp., a development of an oil company.

Wide-Cut vs. Narrow-Cut

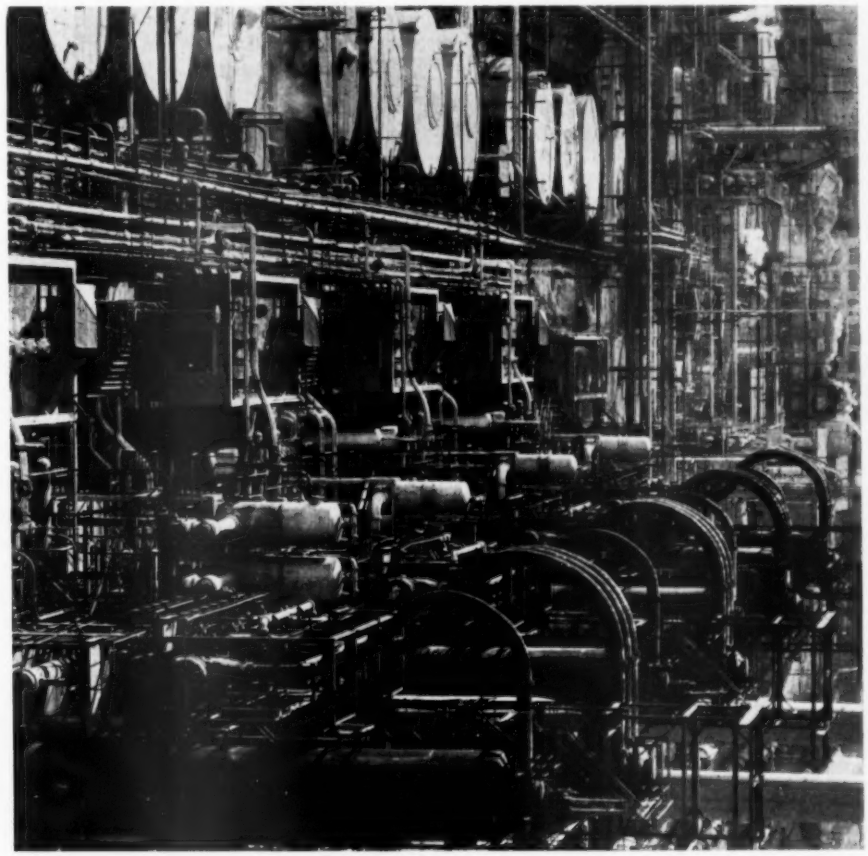
The original petroleum solvent naphtha, the turpentine substitute naturally called "mineral spirits", had to meet flash (100°F.) and volatility requirements. The latter was met and with good yield by a fraction boiling from 300/400°F., or 305/395°, and such remains to this day the boiling range of nearly every refiner's "mineral spirits" or Stoddard Solvent. Moreover, there is no great urge to change this width of cutting. It provides easy brushing and flow in most paints, then quickly sets the film and gracefully leaves in time to permit an early start toward air oxidation at atmospheric temperatures, or rapid polymerization in the industrial baking oven.

Much faster set-up and long tack time, essential to manually applied adhesives, call for considerably wider cutting. Conventional "rubber solvent" boils from 100/275°F., the long "tail" providing an extended working period. Conversely, solvents for mechanically applied adhesives and spreading "doughs" which frequently contain high molecular weight polymers must permit good flow-out before the film sets. Then, before the coated sheet is rolled up on itself, the solvent molecules must pick their way through the maze of polymer chains and make a clean getaway into the air stream above. Just how narrow the cut should be is the subject of much discussion. Suppliers of the superfractionated 10°F.-wide heart-cuts point to their obvious superiority over the largely used and considerably cheaper 70° "narrow-cut" solvents. Much depends upon the solute, and, in the vegetable oil and fat-extraction industries, upon the nature of the matrix.

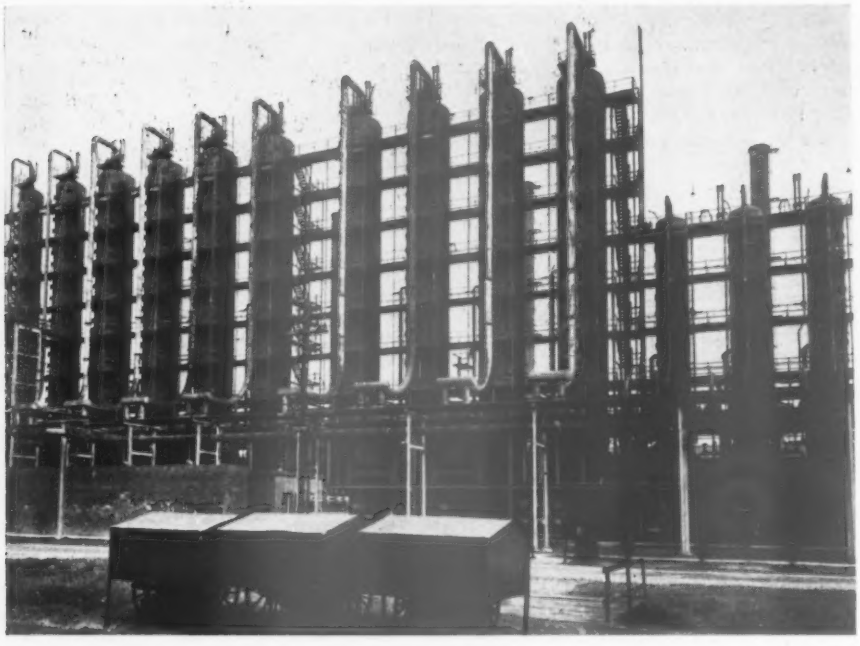
Vegetable oils are successfully extracted with 180°F.-wide naphthas, and enough of the tail is recovered by a steam sparge to hold solvent loss at an economic level and keep the extracted matrix suitable for use as fertilizer. The somewhat higher priced 70°F. fractions are preferred when the extracted and sparged solids are eventually to be sniffed and tentatively tasted by chickens. Perhaps, if we ourselves are to be fed directly with naphtha-extracted proteins we shall specify C.P. normal pentane and nothing else.

The modernization of organic protective coatings began with a rush after World War I. Nitrocellulose lacquer got off to a big lead, and was not overhauled by synthetic enamels until barely 10 years ago. Since then, all kinds of new developments have made their bids. Coming from the industry itself, and from its manifold suppliers, they have merged so effectively that now the "paint job" is an outstanding contributor to the success of World War 2. This time, petroleum naphthas were not the cheap substitute. Instead, they have actually made possible the superlative surface protection afforded every piece of battle equipment that rolls or flies, or holds aviation fuel or lighter-than-air gas. Enough solvent was there, and the quality was right.

With every drop of toluene wanted for explosives, a similarly volatile petroleum substitute containing the necessary 70% of aromatics to dissolve the synthetic rubber in bullet-proof cells and



This equipment segregates contiguous fractions in petroleum solvent refining. Left are run-down tanks, control and pump house in center, fractionator columns and heat exchangers on right



Part of a battery of fractionation towers used for recovering petroleum aromatics as solvents

barrage balloon cloth, as well as the resins required for prime-coating the airplane acreage, was a ready and thoroughly proven commodity. More recently, a companion petroleum xylene fraction has supplemented the supply for purposes where a somewhat lower volatility can serve.

For slower drying coatings, a 92%-aromatic petroleum naphtha, boiling from 270/350° and flashing above 80°, is used 50/50 with mineral spirits to thin the lustreless olive drab which so effectively hides our mobile Army equipment. It also aids the application of the flame- and water-proofing saturant to Army and Navy canvas. A still heavier naphtha, 350/410°F. and over 90% aromatic, dissolves synthetic resins in camouflage paints. In peacetime these two solvents contributed in large measure to the almost incredible durability of our glistening automotive and refrigerator enamels. Naturally, they will be called to serve with the new post-war coatings.

The pressure for low solvent cost—measured in differentials of an eighth of a cent—being what it is, and the difference in performance between an established product and a newly offered, costly, and highly concentrated solvent being, for most purposes, as small as it generally is, one wonders how these new products ever manage to take hold. The answer is wrapped up in the chemist's desire for something better. Usually, the improvement is the result of joint efforts of both the supplier and consumer laboratories. But no matter how promising the new material may appear, it must eventually pass the examination of a recognized test group, e.g., one of the Nationally Federated Paint and Varnish Production Clubs.

Seldom is an inferior product foisted upon the paint industry. Each Production Club, in nearly every large city, has its technical committee, its annual research program, and one or more annual technical reports. Suppliers are invited to serve on committees, and are naturally expected to discuss their own products as well as those of the competition. As a result of one of these programs, the Philadelphia Club contributed the earliest and most successful standardized test for naphtha solvency.

Brain-child of S. R. Kiehel, 1927 Club President, the kauri-butanol test was improved by the club in succeeding cooperative work covering a period of several years, and it continues as the leading specification for solvency. More recently, with the influx of aromatic petroleum naphthas, the club recognized the need for an accurate and precise estimate of aromaticity. Now the "Philadelphia Club Method", resulting from three cooperative programs in 1938 and 1939, is specified for testing aromatic naphthas by several war bureaus.

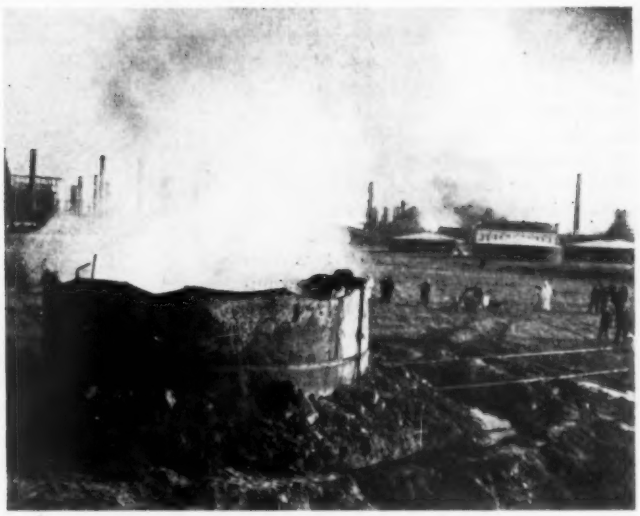
Post-War Solvents

Two hydrocarbon types which as yet are not for sale as solvents show promise for the future. Highly branched isoparaffins have no better or worse solvency than straight-run naphthas, but they nevertheless confer a much higher viscosity on resin and rubber solutions, and thereby supply an additional tool to the coating formulator. Their anti-knock value in aviation gasoline will be the same after the war, so potential solvent users will have to bid high. On the other hand, since alkylation and other refinery processes supply mixed isoparaffins and even some of the individual hydrocarbons in a state of high purity, it appears that a few will become competitive in specialty fields.

Even less is known concerning the future worth as solvents of the other group of postwar hydrocarbons, the individual aromatics which boil above toluene. To date, ethyl benzene is the only one made in quantity. Orthoxylene, not yet available, has been described as a desirable solvent, and possibly its substitution for the cheaper mixed xylenes may be justified for certain special work. Commercial separation and purification of the higher boiling aromatics must, however, await more peaceful times.

Petroleum solvents play an important part in the manufacture of protective clothing worn by this worker in the sulfur dioxide plant of an oil company refinery

Experimental fire control test tank as it appeared before application of foam. It is allowed to burn thus uncontrolled for five minutes



Appearance of tank following successful application of foam. Fire has been extinguished, but steam is rising where foam touches still hot sides of tank

Testing Ground for Fire Control Equipment Set Up By Refinery Proves Value

IN THE interests of improved refinery fire-control equipment, Standard Oil Co. of Ohio has made testing facilities at its Toledo, O., plant available to manufacturers of fire-fighting equipment. Moreover, all interested parties, whatever their company affiliation, are invited to attend the test frequently made there. This arrangement is an outgrowth of the company's own interest in advanced fire protection measures.

The most recent tests run at the Toledo test ground were experiments with apparatus for generating mechanical foam. This type of foam for extinguishing oil fires, while comparatively new to this country, has been used for many years in Europe. Several American fire-fighting equipment manufacturers now are developing mechanical foam extinguishing apparatus for general industrial use.

Many years ago Sohio evolved the philosophy that the way to put out an oil fire was to "git thar fustus with the mostus", with apologies to a famous Civil War general. Accordingly, it has purchased and maintained sufficient equipment to assure having everything necessary to handle a fire under the worst possible conditions, commensurate with sound economics. Then, if the fire is not that bad, still they have available the facilities to snuff it in a hurry. As a result, the fire loss has been low, and the savings in insurance premiums have amply justified this policy, company officials state. Fire prevention work has paralleled the interest in fire control work.

A year ago it was decided to reserve an isolated spot on the tank farm at the Toledo refinery for an employes' control training school. An old tank, 30 ft. in diameter and without a roof, was installed in the center of this area so that it can be supplied with various petroleum products, or with crude. From time to time various devices purchased by the company for fire fighting were installed on the tank, and an appropriate combustible run into the tank in sufficient quantity to simulate actual working conditions. The men assigned to fire-fighting duty were brought to the spot to see what happened under the test conditions. After they had received proper instruction in the use of the facilities provided, the material in the tank was fired and the men used the equipment on test to put out the blaze. This was repeated, especially with new fire-fighting equipment, until the fire fighters were thoroughly familiar with their equipment and its performance.

Available to Equipment Makers

When fire equipment salesmen called on the company and preliminary study indicated further investigation of the apparatus was warranted, demonstration equipment was installed on the old, buckled, fire-beaten tank. Under the supervision of fire-control engineers, the contents were ignited and first-hand experience on the effectiveness of the demonstration equipment was thus obtained. In this way, the company could keep up-to-date on advances in fire-fighting equipment. At the same time, the manufacturers too learned a lot about how their equipment performed under actual conditions encountered in refinery fires. Not the least of the advantages of this kind of a test was the knowledge that, if the experimenters did lose control of the fire, the loss would be confined to the tank, contents, and the demonstration fire-fighting apparatus.

So valuable to the oil company has been this means of testing fire-fighting methods and equipment that the old tank has been made available to equipment manufacturers for experimental work. Sohio does not charge for furnishing the combustibles or the services of its men in putting the equipment in place and assisting the experimenters. The manufacturer, in turn, agrees to let Sohio fire fighters attend the tests and also representatives of other oil companies and fire-fighting equipment makers, as they desire.

Experimental equipment tests were recently run by National Foam Systems, Inc., of Westchester, Pa. The equipment under test was installed to determine various minimum mechanical foam requirements to extinguish burning refinery slop-oil, and to compare them with requirements of National's chemical foam under the same conditions. The equipment was entirely experimental and this was the first full-scale test with various methods of application. By mechanical foam is meant a foam generated by the admixture of air with water containing a foam-stabilizing agent. This distinguishes it from chemical foam, generated by the reaction in water solution of two chemical mixtures evolving carbon dioxide gas.

In these tests the 30-ft. tank was equipped for product-line application of foam (so-called subsurface injection); also for liquid-surface application through two diametrically opposed headers at the top of the tank, connected to pipes into which were inserted portable foam-nozzles; and for liquid-surface application through a revamped, conventional chemical-foam distributor-chamber at the tank top. The dyke around the tank later

was filled with oil and ignited, to demonstrate the effectiveness of the portable foam nozzles on such fires.

A description of one of these tests, subsurface application of extinguishing medium through the product-line, will give a general idea of the procedure.

The tank contained about two feet of refinery slop-oil which was low in volatiles. Slop-oil now is used exclusively in these tests, in the interests of conserving refined products and crude needed for the war effort. Formerly, gasoline, kerosine, fuel oils, cracking stock and other fractions, as well as crude, were used as test material.

When all was ready, blazing excelsior soaked in gasoline was thrown into the tank to ignite the contents. The fire was permitted to burn uncontrolled for five minutes. Then attempts to extinguish were begun and the time required for control and for complete extinguishment was noted, along with the amount of water and chemicals necessary.

One of the most effective applications tried was through the product line, injecting foam underneath the surface of the blazing liquid. Theoretical considerations for this type of application are attractive, because the foam or chemical is not subjected to the heat of the blaze until it rises to the surface of the liquid. Thus, chances for evaporation or decomposition of the foam are minimized and the blazing liquid is cooled as well. Injection is far enough below the surface to avoid agitation of the liquid; instead, the foam rises and blankets the surface beginning at the edge, flowing circumferentially until the entire blazing surface is covered. One objection to this application is that the pumping equipment must not only supply foam, but the foam must also overcome the hydraulic head imposed by the liquid contents of the tank and resist dissociation while rising to the surface.

View of an experimental-type mechanical foam proportioner. Operator is filling one of the two compartments with foaming agent

View of slop oil tank contents after fire has been extinguished with chemical foam

Same tank contents after extinguishing fire with mechanical foam. Note difference in texture between two foam types

One of the objections to surface application which is said to be avoided by bottom injection is the possibility that the water in the foam may be dissociated into hydrogen and oxygen by the flame temperature, thus effectively adding fuel to the fire as these constituents recombine. Another objection is that the foam is evaporated into steam, and the chemical consumed as well, before it reaches the blazing surface of the liquid. Thus, bottom application should blanket the surface more quickly with a lesser quantity of foam, chemical or otherwise, because none is lost en route.

In the specific test, mechanical foam was thrown at the rate of 400-500 gal. per minute for six minutes—requiring 50 gal. of foaming agent—through the product line into the slop-oil before the blaze was under control. It was estimated that 4 gal. of foam resulted from every gallon of liquid pumped—a lesser quantity of foam than with surface application because of the hydraulic head imposed by the contents as well as resistance to its rise from the viscosity of the slop-oil.

The mechanical foam extinguishing apparatus consisted of a closed tank divided into two independent compartments which hold the foam-making liquid, and the necessary hoses and nozzles for application. Operator changed compartments at will, filling one while the other was supplying the nozzle with fluid. Water from the fire hydrant is conducted through a valving arrangement at the top of the tank, where it receives the foaming agent. The tank, called a "pressure proportioner", introduces the foaming agent into the water stream under pressure to form a solution for delivery to the mechanical foam nozzle at the end of the discharge hose. When the stream reaches the base of the nozzle, it is divided into a series of annular jets, placed circumferentially around the 'disk-like base, and thence into the nozzle proper. The outer casing of the nozzle-base is similar to a gas or oil burner, permitting air to be sucked into the nozzle base also, and to be whipped into a high-velocity jet of foam.

In this test, the nozzle was permanently attached to the product line entering the bottom of the tank at one side. Piping ended flush with the inside of the tank. In the product line between tank and nozzle were a gate valve and a check valve, with the gate nearest the tank serving as a safety block in the event the check valve should become defective and fail to hold the tank contents.

Foam application continued for a full 12 minutes to assure that the blaze was out and would stay out. Afterwards, witnesses climbed a ladder placed against the tank to examine the foam blanket. As soon as the foam was dispersed and equipment readied for another mode of application, the contents were again ignited, allowed to burn unmolested for five minutes, and another way of extinguishing the blaze tried.

Some 38 witnesses, including representatives of Sohio, other oil companies, PAW, the armed forces and fire-fighting equipment manufacturers, witnessed the tests.

Safeguarding from Faulty Welding In Installing Alloy Steel Liners

Strip Weld Method Developed by Metallurgical Engineer Prescribes Technique Which Facilitates Good Workmanship

PREPARATIONS for running crude oil of high sulfur content in refineries where the equipment was originally installed for handling "sweet" crudes will include in some instances lining vessel interiors with corrosion-resisting alloy steel. Since this work will have to be done in the field and in some cases at least with contract labor, the quality of the workmanship available may be lower than anticipated as a result of wartime conditions. Accordingly, methods for doing the work under conditions as nearly "foolproof" as possible will be advantageous to refiners.

A method for installing liners which provides that poor welding can be detected at an early stage in the work has been developed by a metallurgical engineer with considerable former experience with a large steel manufacturing company. The system of checks and inspections prescribed with this method will guard against failures and leaks and confine their effects, it is also stated. Thus a leak at one point will not imperil the protection given by the rest of the liner.

In brief, the procedure differs from other methods of applying liners in that each strip is individually welded to the base metal of the vessel at all four edges, leaving a space between adjacent strips to be filled later by a single-pass "stringer bead." This filler is not run until all the strips have been welded, beads sand blasted, and the work approved by the refinery inspector. Use of several small-capacity welding machines (150 amp) is advocated instead of fewer 300 amp machines, to secure a closely controlled, relatively low current. The method, developed by K. E. Luger, Houston, consulting metallurgical engineer, formerly with Carnegie-Illinois Steel Co., deals for the most part with strip lining. "The strip method as against the plug-weld method was used more and more, starting in 1939," stated Mr. Luger, in explaining his study of this particular problem of refinery operators.

Strip Liners Cheaper

"Some refiners having experience in applying stainless steel liners by both methods, found that with 'run of mine' welders (that is, good workmen but not necessarily specialists in either welding of stainless steel or in applying liners) it was appreciably cheaper to install strip liners than plug-weld liners. Where strip liners and plug-weld liners were applied by the same welders to different areas in the same vessel, the portion lined by the strip method was found to be foolproof while the plug weld gave a small percentage of trouble. Except for work done by three refineries there has not been a plug welded stainless liner installed in the Southwest in the past three or four years as far as known, whereas perhaps 100 strip weld liner installations have been made in the same period.

"Experience has backed the earlier choice of strip as against plug-weld lining. With the exception of one job, the strip jobs have been about 99.9% free of trouble. In the case of this one job (a contract job), poor workmanship was found to be the cause of the trouble.

"In both the plug weld and the strip weld the success of the job depends on the workmanship. It isn't difficult to do a good job but unless it is good, trouble is likely to develop. Where the refinery has installed strip liners with their own welders as against letting the job out on contract, difficulties have not developed through poor workmanship as far as is known. Engineers of The Pure Oil Co. have written very good papers describing in detail the methods they use and the success they have had with strip liners installed by their method. A number of other refineries have used this method with complete satisfaction both when doing the work with their own welders and even when contracting the work.

"However, it is nevertheless true that, by this two-bead method used by Pure Oil Co.*, it is possible for a welder to slap on a lot of work (cover a large area of the refinery tower with stainless steel strip) which may look "fair" on inspection of the finished job but which is so poorly applied it will give trouble in a hurry. The only way to be absolutely certain that you may not have a poor job using this method with unknown welders is to have a supervisor standing back of every welder 100% of the time, which of course is wholly impractical."

Following is the description by Mr. Luger of his method of applying stainless steel linings to refinery vessels:

By K. E. Luger**

When taking bids on and awarding contracts for the application of stainless steel strip liners to refinery vessels it is desirable to have it clearly understood just how this work should be done. The various means of applying these liners have been described in "USS Stainless and Heat Resisting Steels for the Petroleum Industry" (a Carnegie-Illinois Steel Corp. booklet). If the work is to be done on a contract basis, a specific means should be described. The following procedure is therefore suggested.

The basic thought in drawing up this procedure is that in these times the quality and integrity of the welders available for this contract work may at times be questioned. If the procedure outlined is strictly followed, it is believed a good liner job will result; that is, it will be impossible to get a job that looks satisfactory that will not stand up in service.

It is hoped that this may prove to be helpful both to the refining industry and to the contractors applying stainless steel liners.

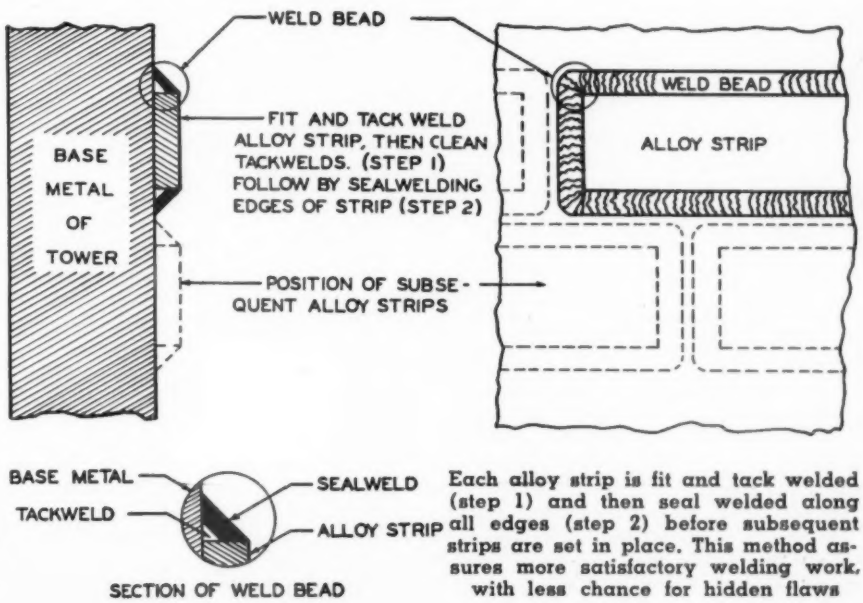
Lining Procedure

1—Strips shall be of low carbon type 410 (0.08% C max., 11½-13% Cr) No. 1 finish, slit edge, cold rolled strip or No. 1 finish sheared sheet.

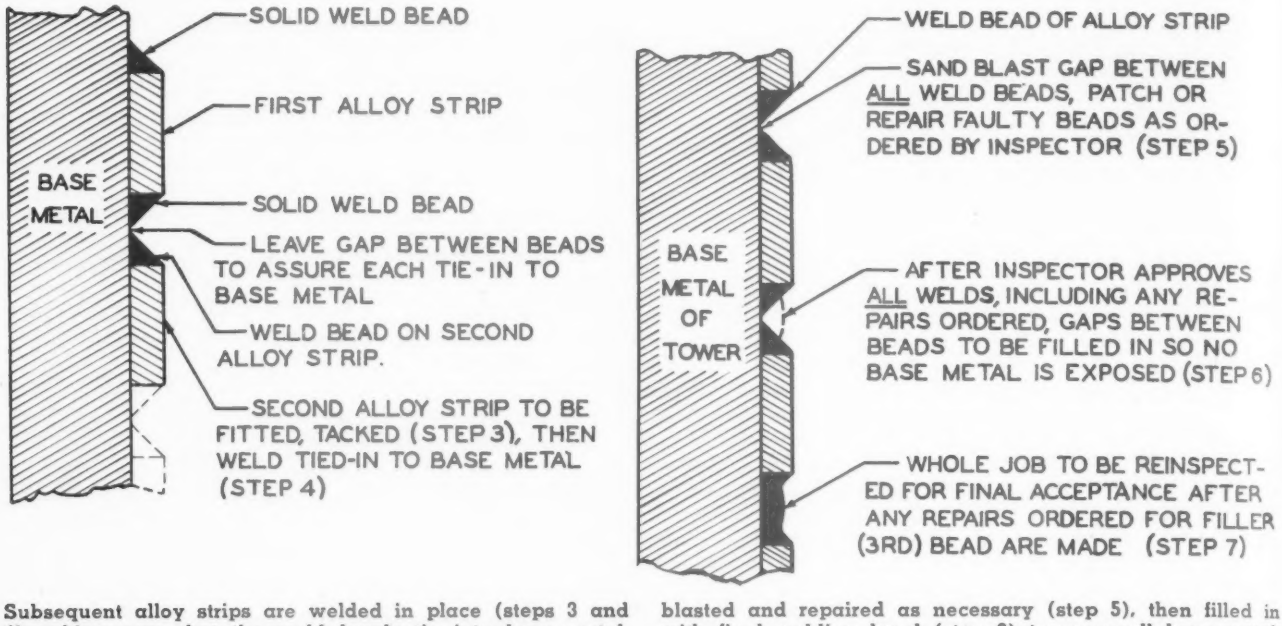
2—The width of strip to be used shall

*McClow, W. W., Corrosion Control in Refinery Pressure Vessels by Arc Welded Stainless Steel Linings, NPN Technical Supplement, Jan. 6, 1943, pp. R-10-14.

**Consulting Metallurgical Engineer, Houston.


WELD BEAD
FIT AND TACK WELD ALLOY STRIP, THEN CLEAN TACKWELDS. (STEP 1) FOLLOW BY SEALWELDING EDGES OF STRIP (STEP 2)
BASE METAL OF TOWER
POSITION OF SUBSEQUENT ALLOY STRIPS
WELD BEAD
ALLOY STRIP
BASE METAL
TACKWELD
SEALWELD
ALLOY STRIP
SECTION OF WELD BEAD

Each alloy strip is fit and tack welded (step 1) and then seal welded along all edges (step 2) before subsequent strips are set in place. This method assures more satisfactory welding work, with less chance for hidden flaws


SOLID WELD BEAD
FIRST ALLOY STRIP
BASE METAL
SOLID WELD BEAD
LEAVE GAP BETWEEN BEADS TO ASSURE EACH TIE-IN TO BASE METAL
WELD BEAD ON SECOND ALLOY STRIP.
SECOND ALLOY STRIP TO BE FITTED, TACKED (STEP 3), THEN WELD TIED-IN TO BASE METAL (STEP 4)
WELD BEAD OF ALLOY STRIP
SAND BLAST GAP BETWEEN ALL WELD BEADS, PATCH OR REPAIR FAULTY BEADS AS ORDERED BY INSPECTOR (STEP 5)
BASE METAL OF TOWER
AFTER INSPECTOR APPROVES ALL WELDS, INCLUDING ANY REPAIRS ORDERED, GAPS BETWEEN BEADS TO BE FILLED IN SO NO BASE METAL IS EXPOSED (STEP 6)
WHOLE JOB TO BE REINSPECTED FOR FINAL ACCEPTANCE AFTER ANY REPAIRS ORDERED FOR FILLER (3RD) BEAD ARE MADE (STEP 7)

Subsequent alloy strips are welded in place (steps 3 and 4), taking care that the weld beads tie into base metal, not lapping over onto previous beads. After all strips are individually welded in place, gap between beads is sand-blasted and repaired as necessary (step 5), then filled in with final welding bead (step 6) to cover all base metal. Thorough inspection is essential before applying final bead

be no wider than 3 in. for 950 to 1000°F. maximum operating temperature; 3½ in. for 850 to 950°F.; 4 in. for 750 to 850°F.; 4½ in. for up to 750°F. maximum operating temperature.

These widths are suggested for typical cracking bubble tower service. Where the on-stream time is relatively short or the temperature changes drastic due to coming on-stream quickly or rapidly quenching when coming off-stream, it is suggested that the maximum widths be somewhat decreased.

3—Thickness of the stainless steel shall be 0.078 in. (The refinery may prefer to specify thicknesses of 0.109 in. or 0.093 in. rather than 0.078).

4—The lengths of the strips shall be no longer than 30 in. This is suggested as maximum since it is believed that the short lengths are easier and quicker to apply. In addition, these short lengths make for more cross welds, which of course are desirable. They also allow the liner to be fitted more accurately. The short pieces can be handled and welded by one man, thus making it unnecessary to have a helper for every welder. This is particularly advantageous in small diameter towers where frequently the helpers would be a hindrance to the welder.

5—The weld rod shall be of 25 Cr—20 Ni of an approved manufacture. It shall be coated for arc welding and shall be ⅛ in. diameter.

6—The welding machines shall be electric motor driven d-c machines in good mechanical and electrical order and shall have a capacity of 150 amp maximum. The small machines are to be preferred to the usual 300-amp machines. When welding at the 75 to 90 amp desirable with the thin stainless steel, very much better consistency in the current delivered can be obtained with the small machine.

7—Welding shall be done with currents no greater than 90 amp for the ⅛ in. diameter weld rods.

8—Strips shall be applied with the long axis horizontal. Horizontal strips are to be preferred to vertical strips on a contract job. The vertical beads are commonly made downhill, since it is considered that uphill welding would be too costly both in labor and in the weld rod. When the major welding consists of these long vertical beads, the refinery never can be certain these welds have "full beads" and have been applied with sufficient "low heat." On the other hand, the major beads on the horizontally applied strips hardly can be made to look good without it being at least reasonably certain that they have full "body" and are well tied into the tower.

9—Before welding the edges of the strips, the welder shall be certain that these edges are snugly up against tower shell, and sufficient tack welds should be used to maintain this snug fit.

10—Tack welds shall be very small—about ¼ in. long. They shall be cleaned before proceeding with the main welding.

11—The tack welds shall be melted into the weld beads as the welding proceeds.

12—Each stainless steel strip shall be completely welded as applied; that is, a number of strips shall *not* be "fitted up" by tack welding, and the main welding left for later. Each strip shall be seal welded along all edges before the next adjacent strip is applied. It is believed that far better workmanship can be obtained by the individual welding of strips rather than by the "fit up" method. There is less likelihood of a "leaker" affecting more than one strip. It is easier to assure perfection in the weld beads (lack of slag holes) because other strips are not in the way. There is much more certainty that each weld bead is tied into the vessel wall throughout its entire length. By gauging from the weld bead already laid, it is far easier to obtain the correct spacing between strips.

13—Weld beads of each strip shall be made, cleaned of slag, inspected (this inspection by the welder making the bead), patched where necessary, and the patches cleaned before the next adjacent strip is applied. It is far easier to clean and inspect and patch a weld bead if these operations are performed before the adjacent strip is in the way. Using this procedure there is very much less chance for adjacent weld beads to have "leakers" at exactly the same place.

The welder will have to patch the major part at least of his own poor work; this is much better for morale than to force a welder to patch another's poor work. Using this plan of doing the major part of the patching as the work progresses, there are far less holes for the refinery inspector to catch when he inspects. Therefore he has a better chance of catching all the imperfections. Both the contractor and the refinery supervisor have a better chance of determining quickly and accurately just what kind of work each welder is doing. It then is possible to try to straighten out the poor welders by working with them. If there are welders on the job of such poor quality that they "can't make the job," they can be replaced before they get a chance to botch a great deal of work.

14—Every time the arc is broken, the welder shall clean the bead at the crater and a little back from the crater before again striking the arc. Welding shall be picked up at least ½ in. back from where arc was broken.

15—After the first strip has been completely welded, the next strip shall be applied, so spaced that the weld beads of this next strip shall be thoroughly bonded to the vessel wall throughout their entire length. The weld beads must not be tied into the adjacent strips nor into the weld beads of the adjacent strips. Weld beads should be tied into the vessel wall in order to obtain the maximum strength. By making certain that weld beads of adjacent strips tie into the vessel wall, rather than lapping over onto previously applied beads or strips, better strength is assured. When the weld beads do not lap, the refinery inspector or supervisor can always see the condition of all beads.

If weld beads are laid on top of each other the chances are that a defect (leaker) in the first bead will result in a defect in the second bead; that is, there will be leakage between the strips.

16—Weld beads of adjacent strips shall be no further apart than that a single stringer bead can fill the gaps. There is no need for more room than this. Less time will be consumed in doing the job (less down time), less welding rod, and less labor if this minimum spacing is maintained. The least amount of welding heat applied to or around the thin stainless steel liner material, the better its strength will be.

17—After completing the entire job with strips individually welded on all edges to the vessel wall, the weld beads shall be sandblasted, inspected (this inspection by refinery inspector), thoroughly patched, patches cleaned (re-sandblasted if there are numerous patches), re-inspected (by refinery inspector) to make certain all holes have been satisfactorily patched, and then, if necessary, repatched. *Only* after this thorough inspection and patching of the first two beads shall the final weld bead (third bead) be applied. This final weld bead must not be used to attempt to patch holes in the first two beads.

After the third bead is applied, it is impossible for the refinery inspector or the contractor's supervisors to ascertain the perfection of the other beads. It is impossible to inspect and patch satisfactorily the holes in the other beads after the filler bead has been applied. The filler bead is much easier applied after the other beads and patches have been cleared by sandblasting.

18—The final bead shall then be cleaned (deslagged), inspected by the refinery inspector, and patched where necessary. This bead shall be cleaned, inspected, and patched by the welder as he makes it. The function of this bead is merely to cover and protect the very small amount of the shell of the vessel exposed between the other weld beads. A thin stringer bead will be satisfactory as long as it does cover completely the bare steel of the vessel walls.

19—Each welder shall have a steel stencil for identification and shall use this stencil to mark his work clearly.

Exhaust Steam from Compressors Used in Processing Operations

ECONOMY in fuel consumption is achieved in the Neches Butane Products Co. plant at Port Neches, Texas, by first utilizing high pressure steam to drive a battery of six 1740 hp compressors and then making the exhaust steam available to the plant processing area, where large volumes of heat are required for distillation and other purposes.

The high pressure steam is first introduced to the power ends of the steam engine driven compressors at 450 lbs. pressure. After functioning there the exhaust steam, at 160 lbs. gauge, is conveyed to the plant for use in processing operations. Of the total heat available in the high pressure steam, approximately only 8.35% is used to power the compressor engines, leaving a balance of 91.65% for other useful functions in the plant.

Furnished by Clark Bros. Co. of Olean, N. Y., each of the 6-cylinder compressor units is comprised of a single row of vertical double acting counterflow steam cylinders and two rows of horizontal compressor cylinders, one row on either side of the bed, with all cylinders operated from the same crankshaft.

Each of the 1740 hp units takes up a minimum floor space of 420 square feet, and eliminates the use of numerous smaller engines which would otherwise be required to do the same work.

The Port Neches plant, one of the largest butadiene plants in the world with a rated capacity of 100,000 short tons of butadiene from petroleum a year, was just dedicated last February (*NPN Technical Section, Mar.* 1, 1944, *p. R*-121-126).

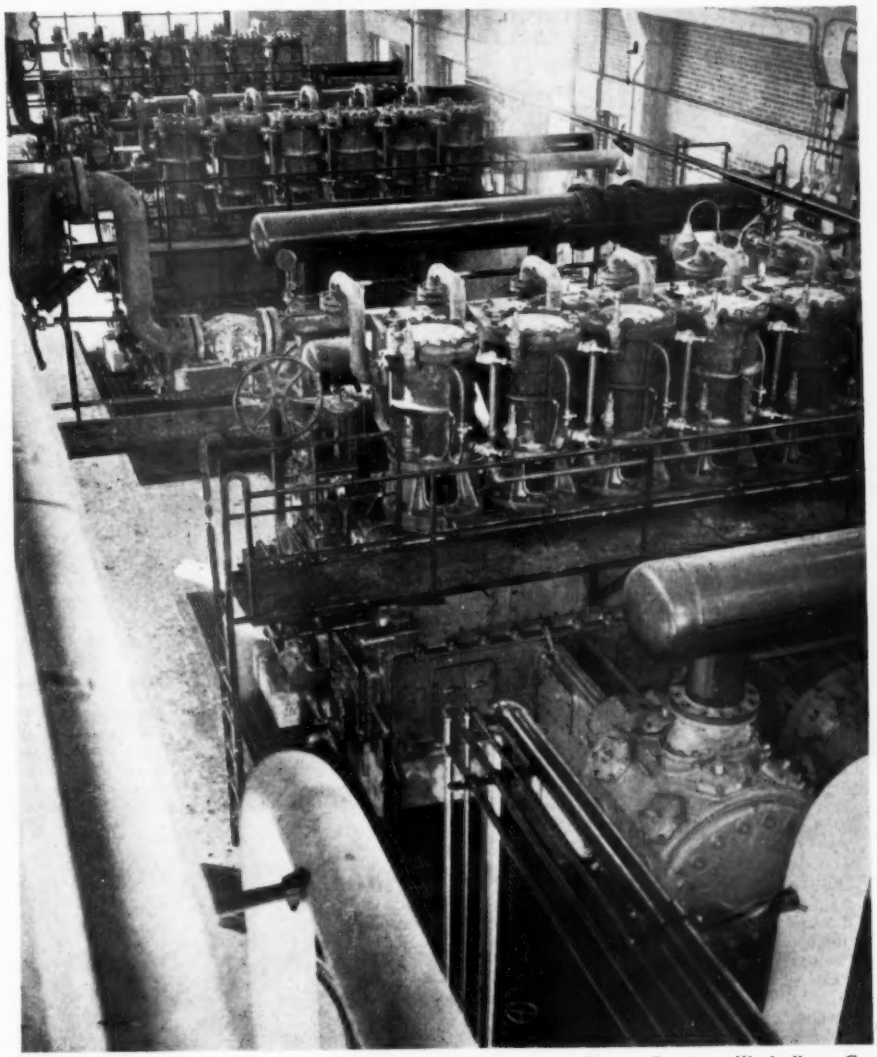


Photo: Courtesy Clark Bros. Co.

Shown above are three of the steam engine driven compressor units installed in the Neches Butane Products Co. plant. The double duty use of steam with these units permits an efficient balance to be struck between the motive power and heating requirements of the plant

Use of the Mass Spectrometer in Routine Analysis of Refinery Gas Samples*

Use of the mass spectrometer for refinery control purposes is described from experience in the operation of an acid alkylation plant. A short method of analysis is applicable where the operation can be controlled on the basis of one or two key components. Analyses can be reported in from 25 minutes to two hours after receiving the sample, this company has found. Operators should be chosen for their skill and technique in handling precision equipment.

*By J. G. Schaafsma***

UNTIL recently routine gas analyses at the Torrance refinery of the General Petroleum Corp. of California were adequately handled by four low temperature fractionating columns with acid adsorption trains for olefin determination. When construction was begun on new plant facilities to meet the growing demand for petroleum products, it became evident it would be necessary to provide for a large number of additional gas and liquid streams. After due consideration of factors such as initial cost, accuracy, elapsed time, and manhours required per sample for various types of equipment, a Consolidated Engineering Mass Spectrometer was installed which now handles all the gas samples. Normally liquid samples, such as gasolines, are still run on the older fractionating equipment. Experience with the instrument over a three-months period has demonstrated it is very satisfactory for routine refinery control work in all processes involving light hydrocarbons.

This paper will include a very brief discussion of the theory and operation of the instrument, and of its performance when used to control an acid alkylation unit.

General Theory

The mass spectrometer is so named from certain similarities it possesses to an optical spectrometer. The latter separates a light beam into its component monochromatic beams by deflecting shorter wave-lengths more than longer ones; while the mass spectrometer separates a beam of moving gas molecules of various types into distinct beams according to mass, the presence and relative percentage of each mass being recorded. In order to secure this unusual effect, the gas is first ionized and the resultant ions given a high linear velocity by the action of an electric field. This, of course, is done in a high vacuum.

Like any other charged particles, the ions can be deflected from their path by passage through the field of a strong magnet. While in the field their paths are curves whose radii of curvature are smaller for the low masses than the high ones. By gradually lowering the electric field producing the initial acceleration, while maintaining a constant magnetic field, the radii of curvature can all be simultaneously and continuously reduced during the course of a run. This means that each mass in turn will have just the right curvature to pass through a semi-circular tube into a slit, and be measured. By keeping the inlet flow rate of gas constant, a record of each mass and of its relative amount can be obtained.

The above procedure would be sufficient if it were not for the existence of isomers of equal mass, such as normal and isobutane. In practice the ionization is severe enough to cause partial cracking of the molecules into fragments of lower mass. Each pure hydrocarbon has its own distinctive spectrum, or cracking pattern, as is illustrated by that of normal butane in Fig. 1. Here the parent peak, corresponding to the molecular weight of 58, is plainly evident, as well as peaks due to the decomposition products. The degree of cracking is sufficiently different for each compound to permit the accurate analysis of mixtures containing isomers.

The actual running of a sample is a fairly simple procedure, involving manipulation of a few stopcocks and switches. Scanning and recording of the spectrum is almost completely automatic, the operator's main duties being that of putting a small portion of the gas sample into the inlet system, setting the accelerating voltage at the proper level before the run, and developing the photographic record after the run. Since the various electric circuits, such as the magnet and filament currents are left on continuously, very little time is required in preparing for the next run.

Scope of the Instrument

Any light hydrocarbon mixture can be analyzed providing the pure constituents are on hand for calibration. At first only samples essentially free of C_5's were run on General Petroleum's spectrometer, but now isopentane, n-pentane and total pentenes are regularly determined. Traces of C_6's (.1 to 1.0%) occur in some of the gases and can be estimated with sufficient accuracy without going through the complete calculations required to separate these components. Any samples containing larger amounts of C_6's and heavier are still run on the older fractionating equipment.

The presence and percentage of oxygen and nitrogen can be accurately obtained and, as time permits, it is planned to try analyzing for hydrogen sulfide, and the light mercaptans as well. CO_2 interferes badly with certain hydrocarbon peaks and is removed beforehand. Water cannot be determined because of its absorption on the glass walls of the apparatus. The accurate separation of hydrogen and methane is easily made, whereas the older equipment gave only an approximate split.

From experience gained to date it appears that the spectrometer is at least as accurate in all respects as a very carefully operated fractionation and acid absorption system, and considerably better than the latter as ordinarily run in routine control work. Table I contains

Table I—Comparison of Results of Gas Analyses by Combined Fractionation and Acid Absorption and by the Mass Spectrometer

Gas Analyzed	Cracking Unit Absorber Release Gas		Cracking Unit Stabilizer Release Gas		Synthetic Gas Sample	
Torrance Lab. No.	3069		3062			
	Mass Spectrometer not	Fractionation and Absorp.	Mass Spectrometer not	Fractionation and Absorp.	Mass Spectrometer	Actual‡ Composition
H_2S	determ.	0.08	determ.	0.22	0	....
N_2	1.6	.....	0.2	0.00	0	....
H_2	10.7	.....	0.2	0.00	0	....
Methane	56.1	66.70*	9.6	7.89	0	....
Ethene	2.7	2.37	1.8	1.69	0	....
Ethane	18.6	20.34	22.5	22.28	20.9	21.0
Propene	3.2	2.78	14.9	14.56	12.8	13.1
Propane	6.0	6.59	37.7	39.67	35.7	35.8
Isobutane	0.6	0.65	4.7	4.65	6.6	6.2
Isobutene	0.4	0.38	3.7	3.78	4.7	5.1
N-butene		0.11	2.7	2.79	6.9	6.4
N-butane		....	2.0	2.47	12.4	12.4
Total	99.9	100.00	100.00	100.00	100.00	100.00

*Includes fixed gases.

‡Pure compounds blended, amounts added being read on a manometer.

*Presented before the California Natural Gasoline Assn., Los Angeles, March 2, 1944.

**General Petroleum Corp., Los Angeles.

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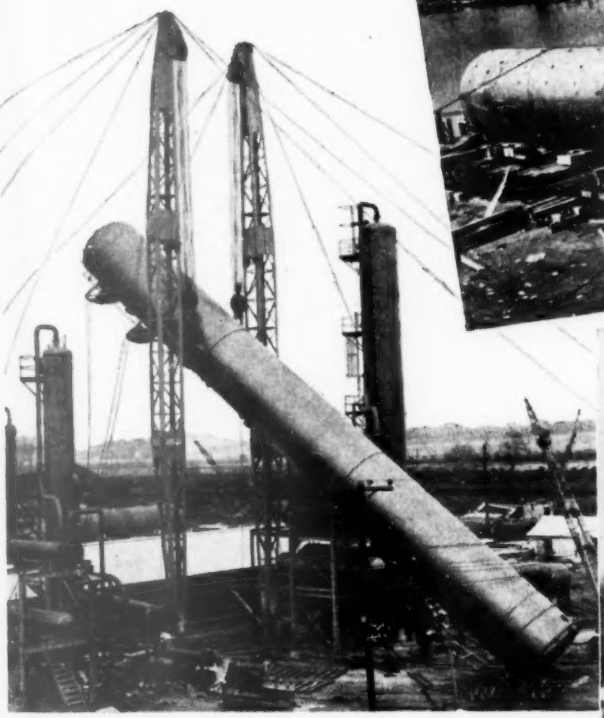

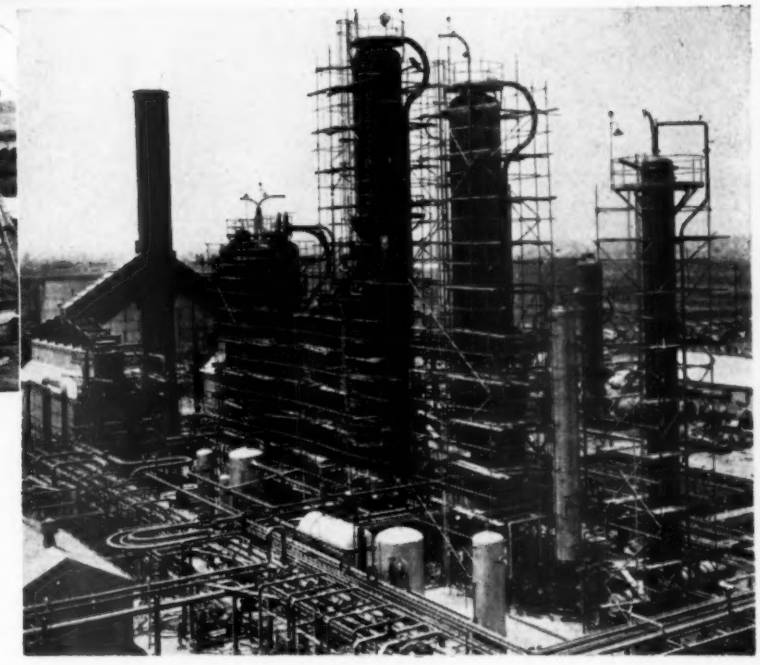

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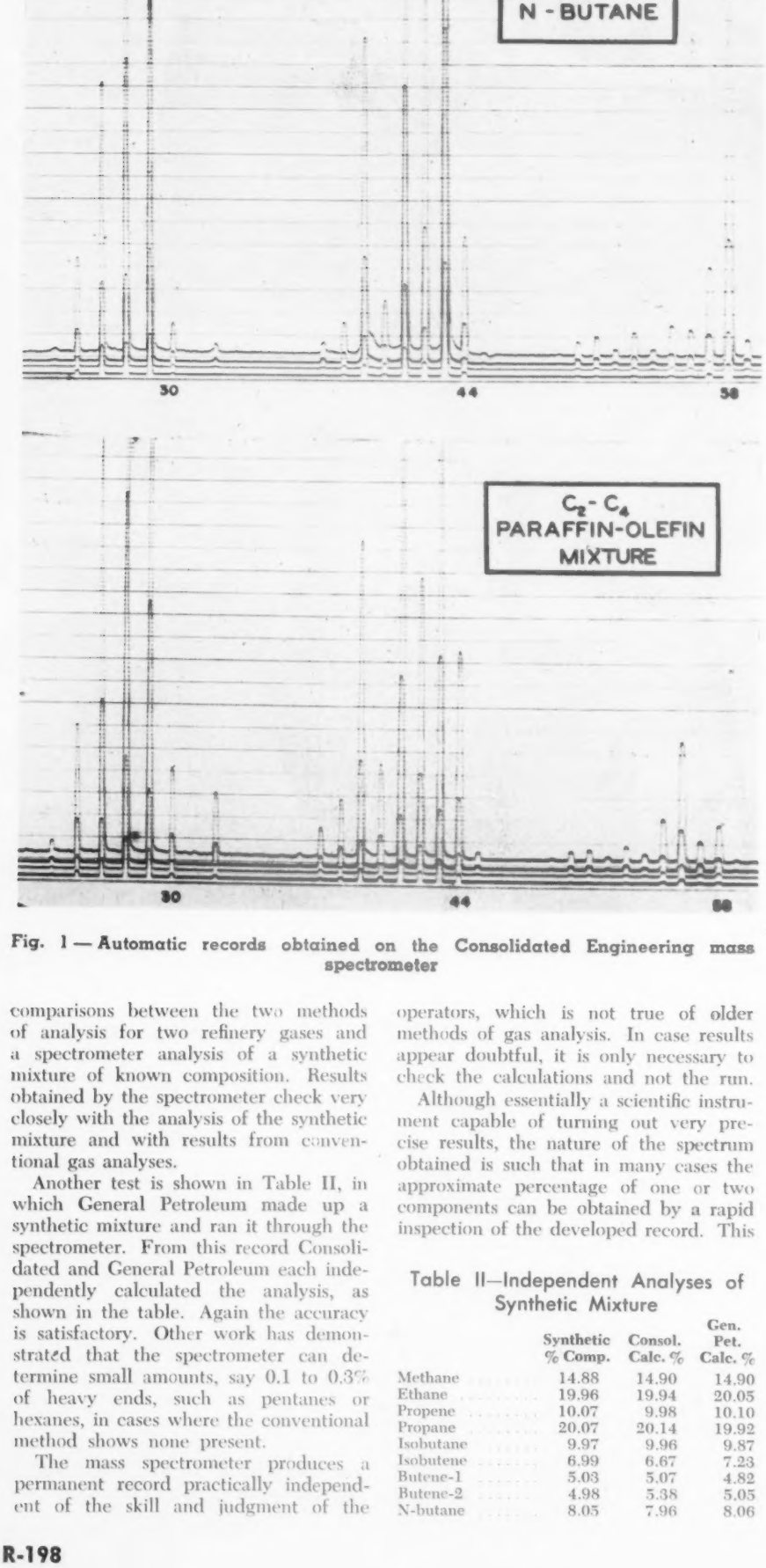

Fig. 1 — Automatic records obtained on the Consolidated Engineering mass spectrometer

comparisons between the two methods of analysis for two refinery gases and a spectrometer analysis of a synthetic mixture of known composition. Results obtained by the spectrometer check very closely with the analysis of the synthetic mixture and with results from conventional gas analyses.

Another test is shown in Table II, in which General Petroleum made up a synthetic mixture and ran it through the spectrometer. From this record Consolidated and General Petroleum each independently calculated the analysis, as shown in the table. Again the accuracy is satisfactory. Other work has demonstrated that the spectrometer can determine small amounts, say 0.1 to 0.3% of heavy ends, such as pentanes or hexanes, in cases where the conventional method shows none present.

The mass spectrometer produces a permanent record practically independent of the skill and judgment of the operators, which is not true of older methods of gas analysis. In case results appear doubtful, it is only necessary to check the calculations and not the run.

Although essentially a scientific instrument capable of turning out very precise results, the nature of the spectrum obtained is such that in many cases the approximate percentage of one or two components can be obtained by a rapid inspection of the developed record. This

Table II—Independent Analyses of Synthetic Mixture

	Synthetic % Comp.	Consol. Calc. %	Gen. Pet. Calc. %
Methane	14.88	14.90	14.90
Ethane	19.96	19.94	20.05
Propene	10.07	9.98	10.10
Propane	20.07	20.14	19.92
Isobutane	9.97	9.96	9.87
Isobutene	6.99	6.67	7.23
Butene-1	5.03	5.07	4.82
Butene-2	4.98	5.38	5.05
N-butane	8.05	7.96	8.06

is possible because in many refinery mixtures there are compounds whose main peaks on the record contain no contributions from other compounds. The heights of these peaks are directly proportional to the percentage of the compound in the mixture, which makes their analysis very simple.

A complete analysis is usually more involved than this because many of the peaks consist of contributions from a number of compounds. Again, however, the contributions of each compound are always directly proportional to its percentage, and much of the calculation involves only arithmetic. For the rigorous solution of a 14-component mixture consisting of a highly cracked gas containing all hydrocarbons through the C_4's as well as hydrogen, air and H_2S, the most complicated mathematics required is the solution of a set of three linear simultaneous equations.

Short methods of analysis are especially applicable where a refinery operation can be controlled on the basis of one or two key components. For example, in a depropanizer purifying isobutane the overhead need only be analyzed for isobutane and the bottoms for propane. Where such a case exists, two short cuts can be used which reduce computing time and instrument time, respectively. The first consists in obtaining a complete record in the spectrometer and obtaining the percentage of the key component by inspection or a short calculation. At any future time the complete analysis may be computed, if required, from the record which is filed. Instrument time can be reduced by scanning a part of the spectrum and securing only that part of the record needed to determine the key component. However, no complete analysis can be calculated in the future.

Calculation by inspection is especially useful in determining the percentages of small amounts (up to 5%) of undesirable heavy constituents caused by improper operation of refinery equipment. An experienced spectrometer operator can become quite proficient and accurate in this very useful shortcut, since the heaviest fractions, say hexanes, produce peaks which stand out by themselves and are due to no other compounds.

All of these partial analyses give the composition as mol percentages. In case the analysis of a liquid stream, say a C_4 cut, is desired in terms of liquid volume percentages, a complete analysis of the cut on a molal basis must first be worked out. It would seem desirable to convert refinery operations to a mol percentage basis wherever possible.

Depending on the type of gas and the accuracy desired, results can be reported within from 25 minutes to two hours after receiving the sample. Considerable time can be saved when only the approximate percentage of one key component is required by the refinery, since an experienced spectrometer operator can, in many cases, secure this figure by mere

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inspection of the photographic record.

Actual instrument time is usually under 30 minutes for all types of samples, but calculation times vary considerably. Accurate determination of a single paraffinic constituent varies from 5 to 10 minutes, depending on whether an isomer is present or not. Calculation for all components of a C_1 to C_4 paraffinic gas takes 30 minutes, and the presence of iso- and normal pentanes may add another 10 minutes. A cracked C_1 through C_4 gas requires about one hour's calculating time because of the presence of olefins, and the presence of appreciable amounts of pentenes may add from 15 minutes to one hour to the time depending on whether they are calculated as a total or as individual pentenes.

About one hour per day, prorated, is spent in calibration of the instrument. Actually, a complete calibration for all hydrocarbons need be run only once in two weeks, while a daily check is made on n-butane alone. This latter run requires under 30 minutes since the equipment is kept "warmed up" overnight when not running three shifts.

The shortest type of run is illustrated by the testing of a depropanizer overhead for isobutane inclusion. In this case instrument time is reduced by operating over a limited range of masses (from 40 to 60).

	Elapsed Time Minutes
Introducing sample	5
Making run	10
Developing	5
Calculation by inspection	5
Total	25

A complete analysis of a cracked gas containing no pentanes would require the following time:

	Elapsed Time Minutes
Introducing sample	5
Making run from mass 10 to mass 66	20
Making run from mass ½ to mass 4 (H_2 requires weaker magnetic field)	5
Developing	5
Calculation for all components	60
Total	95

This calculating time is for an expert well adapted to this type of work.

In addition to saving time through calculation by inspection, some savings are obtained if only total butenes, rather than the breakdown into isomers is desired. When most refinery operations are controlled on the basis of one or two components, and speed rather than extreme accuracy is desired, two operators and one calculator can turn out an average of 14 refinery samples containing C_1 through C_4 in an 8-hour day, when half of them are calculated by inspection. This is equivalent to 1.72 man-hours per sample. If all samples are to be accurately calculated for all components through C_4's, one more calculator must be employed and the man-hours become 2.28 man-hours per sample. The presence of appreciable amounts of pentanes increases the calculating time and hence the number of calculators needed. The number of samples per day put through the machine may be increased in certain cases when most of them can be run over a limited range of masses instead of over the whole range from C_1 through C_5.

Table III—Hydrocarbon Samples From Gas Plant and Alkylation Unit
(Type of Analysis Used and Time Required when Alkylating Butanes and Pentenes Together)

	Type of Analysis*	Key Components	(See §) (See †) Minutes	(See §) (See ‡) Minutes
Gas Plant				
Total Gas from SR and Cracking Units to H.P. Absorber	MS	n-pentane	105	45
Gas from H.P. Absorber	MS	C_1's	45	30
Gas from L.P. Absorber	MS	C_1's	45	30
Raw B-B Depropanizer Feed (from Gas Plant) incl. C_5's	MS	All	85	85
Raw B-B Depropanizer Tops	MS	C_4's	45	30
Raw B-B Depropanizer Bottoms, incl. C_5's	MS	C_3's	85	30
Raw B-B Debutanizer—Tops	MS	n-pentane	85	60
Raw B-B Debutanizer—Bottoms		pentenes	..	60
Alkylation Unit				
Treated B-B to Contactors, incl. C_5's	MS	All	85	85
Recycle Isobutane	MS	propane and isobutane	60	40
Alkylate de-isobutanizer—Feed	Fract.	C_2's, C_1's	480	..
Alkylate de-isobutanizer—Tops	MS	n-butane	45	35
Alkylate de-isobutanizer—Bottoms	Fract.	isobutane	360 (thru C_5's)	90
Alkylate debutanizer—Tops	MS	isopentane	35	25
Alkylate debutanizer—Bottoms	Fract.	n-butane	300 (thru C_5's)	90
Isobutane depropanizer—Tops	MS	isobutane	35	25
Isobutane depropanizer—Bottoms	MS	propane	35	25
Alkylate rerun—Tops	Fract.	C_5's	..	120

§Total Elapsed Time for Run and Calculations.
†Complete for All Components. ‡For Key Components Only Using Short Cuts.
*M.S.—Mass Spectrometer; Fract.—Low Temperature fractionation and acid absorption.

Table III shows a list of samples from a gas plant and alkylation unit, showing time required for complete and for partial analyses. In order to better illustrate the range of samples that can be handled by the spectrometer, this example shows some pentenes included in the isobutane-olefin charge to the alkylation unit contactors, although this is not a general practice. Some of the streams containing appreciable amounts of hexanes and heavier are still run on the fractionating equipment, as they are at present considered too complicated for routine analysis by the spectrometer. However, other laboratories have analyzed certain C_6 and C_7 concentrates by means of the spectrometer.

It is considered desirable to have two operators per shift for satisfactory performance and one or more calculators, depending on the type of samples run. In our case the operators are college graduates with considerable petroleum laboratory experience. It is desirable in any case for at least one person to have a good technical background and that all operators be chosen for their skill and technique in handling precision equipment. One operator puts the sample through the instrument and watches the controls, while the other connects and disconnects the sample bombs, develops the records and assists in the calculations as time permits.

At Torrance, calculations are handled by a girl with no training except first year high school algebra. Speed and accuracy are desirable traits in this case, the calculations being detailed, but not at all difficult. About two months are required to break in a calculator, although much of the work can be picked up in a few days. An aptitude test might be advisable to be sure of securing persons well-suited for this work.

Maintenance work requires the part-time services of a skilled electrician. In our case repairs are made by a refinery electrician with the help of one operator who has familiarized himself with the various electrical circuits. In case of failure of the analyzer tube or a galvanometer, the repair work is done by Consolidated Engineering Corp. in Pasadena. Delays are avoided by keeping a spare tube and one galvanometer on hand which can be installed by the operators.

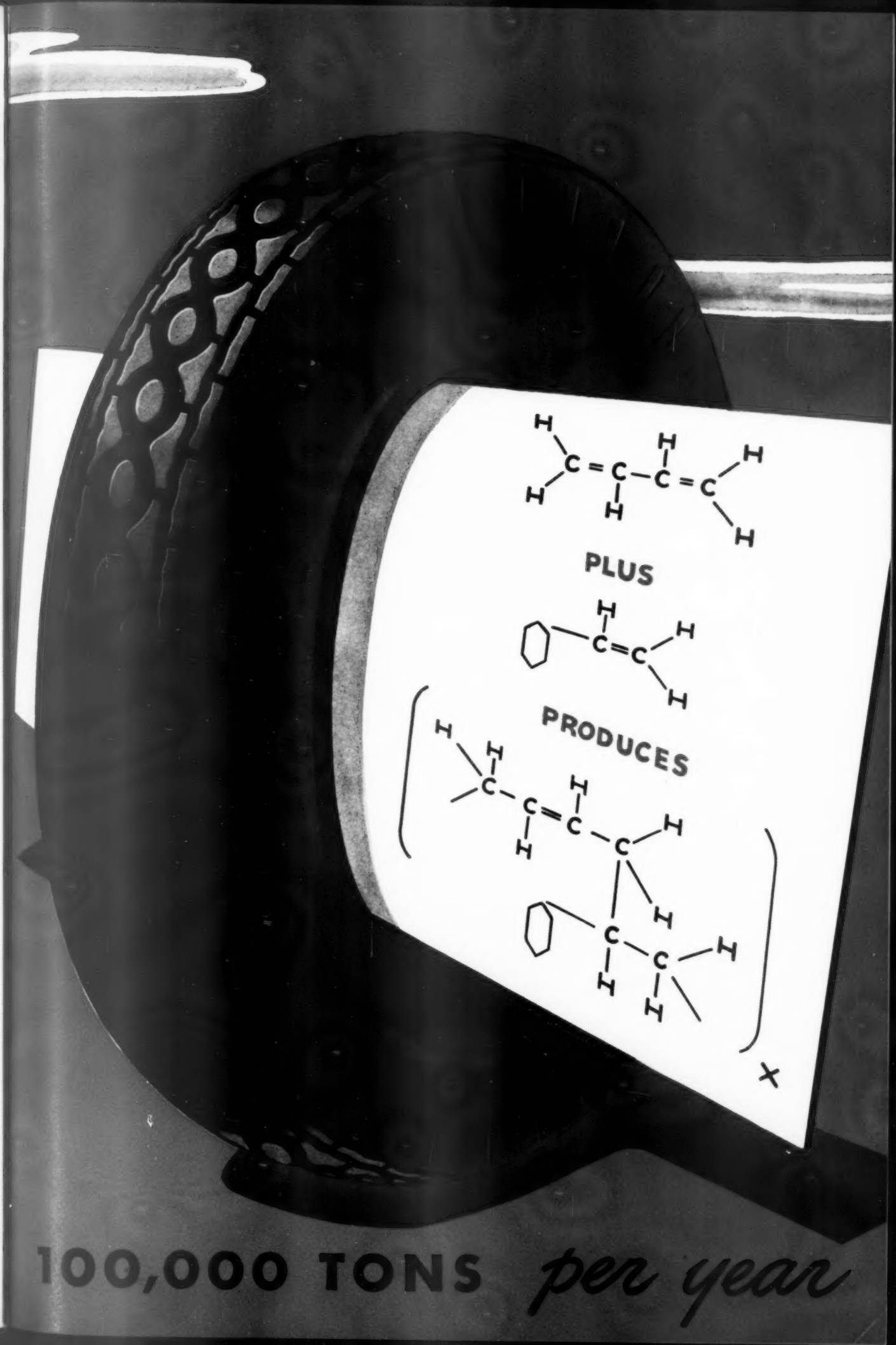
Due to the extremely small amount of gas actualy required for a run (less than 1 cc of gas at one atmosphere) the size of the sample is dictated by convenience. At Torrance 6-ounce ICC cylinders are used for high pressure samples and glass containers for gases at atmospheric pressure. Both types are equipped with two valves, for filling by water displacement.

Elsewhere in the literature may be found a more complete discussion of the technical details of the spectrometer and also the experiences of others in the use of the instrument[1]. The writer is indebted to D. J. MacLaren for preparation of the data used in this report and to the Consolidated Engineering Corp. for permission to publish this article.

[1]H. W. Washburn, H. F. Wiley, and S. M. Rock. I. and E. C. Anal. Ed., Vol. 15, No. 9, 541 (Sept., 1943)

O. L. Roberts (The Atlantic Refining Company). *Petroleum Refiner*, Vol. 22, No. 5, 107 (May 1943)

"Mass Spectrometry", Technical Section, National Petroleum News, Vol. 35, No. 22 (June, 1943).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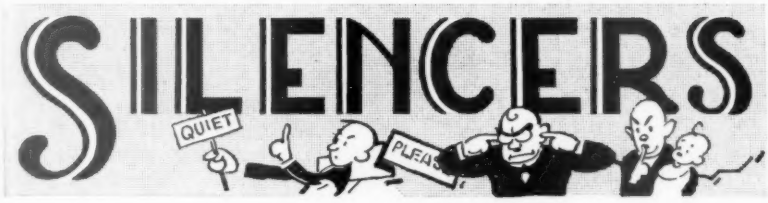

For Diesel and Gas Engine Compressor Sets*

The importance of silencing the operation of installations of Diesel or gas engine compressor sets under certain conditions is discussed, together with the problems encountered in lessening the intensity of the sound. The effect on the back pressure of the engine must be considered. Difficulties in measuring back pressure in field installations are presented.

Different types of silencers are described and the modern trend is said to be toward a "preventer" type. This smoothes out the gas surges coming from the engine or in a compressor intake so they do not create sounds when coming into the open air.

*By R. B. Bourne***

THE PROBLEM of satisfactorily silencing the exhaust of an internal combustion engine, or the intake of a reciprocating compressor, can be solved only by a complete knowledge of the nature of the problem. Before describing silencers in detail, suppose we discuss the noise problem, and some of the factors which have to be taken into account, in the design of a suitable exhaust system.

When an exhaust valve opens or a port is uncovered there is a sudden release of gas under pressure into the exhaust system, which, being an acoustic system, having mass, elasticity, and resistance, may be shock excited into oscillation. The frequency and intensity of the oscillations thus produced depend on the intensity of the initial surge and the physical dimensions of the exhaust system. Many of the oscillations produced are of audible frequency and of sufficient intensity to be annoying. Each individual explosion produces a whole train of sound waves, much like the effect of opening a bottle of champagne. If the explosion frequency of the engine is so related to the natural frequencies of the exhaust system, these sound waves may be vastly reinforced.

In addition to the sounds thus created, there exist also a number of high intensity, high frequency noises, in the form of transients, which we might call "bang" noises. These transients which accompany the initial surge of exhaust gas may be of sufficient intensity to strike heavy mechanical blows on the inside of piping and silencers, and they sound just like that. More than one silencer has been suspected of having loose parts rattling around its insides. We call this effect "shell noise". Of course, an exhaust line explosion as such may actually wreck a silencer, if it is not strong enough to withstand such abnormal pressures. One otner thing deserves mention at this point. A heavy surge travelling down an exhaust line will change the shape of its wave front in such a manner that, after a certain distance, the rise in pressure at a given point may be practically instantaneous. It is much like a water wave breaking on the beach. Shell noise is at its worst when this condition obtains.

Degrees of Quiet

How quiet must the final exhaust or intake be? It all depends on what the neighborhood will stand. Satisfactory noise conditions range all the way from those demanded by the hypersensitive lady who is acutely conscious of the fall of a pin to those accepted by the roving engineer, who "likes the sound of it". In some cases, there may be no audible noise at all, yet sub-audible sound waves or pulsations may be present in sufficient strength to cause secondary effects, such as the rattling of windows and dishes and the shaking of buildings. This latter condition may be serious. Often, the engine itself sets up vibrations in the ground which may travel considerable distances, and affect houses or other buildings. These cases are sometimes very difficult to pin down, since the frequencies present in the ground are generally the same as those which are air-borne.

In any event, the local conditions generally determine how good the silencing must be to be satisfactory. Low frequency sounds may carry considerable distances and when they encounter a receptive local condition, such as a nicely tuned alleyway or courtyard, these waves may be considerably amplified. The intensity may be increased to a point where there is a sensation of pain and discomfort. Speech may be modulated. What happens then is that the vocal chords are forcibly vibrated at the frequency externally present. The whole body vibrates and one instance is recalled where the effect was strong enough to blur the vision.

Two unusual cases come to mind. A man lived across the street from the local ice plant where the Diesels were pretty well quieted. No sound from them could be heard in his yard. Nevertheless, he stated that his bedroom was most uncomfortable when the plant was running. Investigation disclosed that his window was equipped with the old-fashioned side catches, whereby the window was either closed, partly open or fully open. He always opened this window to the first stop. Under these conditions, the size of the opening, together with the volume of the room, conspired to form a good resonator, nicely tuned to a practically sub-audible frequency escaping the exhaust. He was sleeping in a resonator.

The other bedroom story concerns a lady who had a standing wave pattern in her house. The points of maximum pressure happened to be so arranged that one of them was right at the head of her bed. Standing alongside the bed, nothing could be heard. I was asked to lie down on the bed and, sure enough, the lady was right. She had temporarily solved the difficulty by sleeping with her head at the footboard. In both these cases, the trouble was cleared up without difficulty. Steady recurrence of a noise is generally much more annoying than random noises of much greater intensity.

Measuring Sound Intensity

Many attempts have been made to specify the degree of silencing required or the noise level acceptable. Of course, we can easily measure sound levels with a portable meter which reads the answer directly in decibels. I slipped in this cabalistic term on purpose, so as to explain and debunk it. Slick specification writers have pounced on it and mangled it until its own mother wouldn't recognize it. It is as a matter of fact an extremely useful concept when understood and not abused. Let's see what it's all about.

It so happens that the range of intensities in commonly encountered sounds is extraordinarily great. The human ear can just about detect differences in sound energy of two to one. Its response to sound stimulation is approximately logarithmic, not arithmetic. We could make an instrument which would read sound pressures in pounds per square inch if we wanted to. The sound pressure in this room for instance can be measured, but the answer in pounds per square inch would be a meaningless small number. We are much more at home with numbers greater than one than with small deci-

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*Presented before California Natural Gasoline Assn., Los Angeles, Jan. 6, 1944.

**Director Research, Maxim Silencer Co., Hartford, Conn.

mals. Furthermore, we don't like to have numbers too large to grasp. Imagine having to say that the sound energy in here, right now, is 1,250,000 times 10 to the -16 watts per square centimeter! Who would have guessed it? How much simpler to say instead, it's 61 db?

Well then, where are we? The average human ear can just detect a sound level of 10 to the -16 watts per square centimeter. A simple logarithmic concept, which gives us numbers easy to grasp and more or less follows the sensation of sound by the ear solves the whole mystery. The decibel is a logarithmic ratio, between the sound to be measured and that tiny level mentioned a minute ago. It is not an absolute quantity at all but common usage has more or less made it so. When we say a sound has 70 db we imply that it is 70 db above the threshold of hearing. For those interested in the formula, the number of decibels, corresponding to the ratio of two sounds having energies W_1 and W_2, is ten times the logarithm to the base 10 of the ratio W_1 over W_2. If sound pressures are used, the number of db is 20 times this logarithm, instead of 10.

Now there are some other little matters that deserve consideration. Suppose the sound level of an exhaust pipe measured 10 feet off the end of the pipe is 90 db. Will it be offensive? It depends on where the listener is and what other noises are present and their quality and intensity. If the listener resides in a sound level of 90 db, he probably won't be much aware of another noise of 90 db being thrust upon him. Of course, the exhaust noise falls off pretty fast with distance, so that by the time it has travelled a couple hundred feet, its level may be down to, say 70 db. We have encountered cases where exhaust pipes were terminated right outside a window with people inside. In such cases, the silencer must not permit the escape of noise much above 60 or 70 db. If the window is in a room full of boiler makers on double time, obviously the noise reduction requirements of the silencer might be slightly modified. A silencer giving about 20 db noise reduction will fulfill the requirements of most installations.

Must Consider Back Pressure

Now, of course, there is much more to silencing an engine than just reducing its noise. After all, we have to allow the engine to run! If we could get away with a cork driven snugly into the end of the exhaust pipe, it would effect all the silencing demanded by the most finicky neighbor. But, alas, it would impose high back pressure on the engine. So here is the number two bogey, right out in the open. Any device or pipe through which gas passes offers a certain opposition to its flow. It is said to have back pressure. The products of combustion have to be moved out of the way in order to make room for more of the same an instant later.

In general, it is desirable to have the back pressure of the system as low as possible consistent with good noise reduction and a not too large silencer. High back pressure is said to burn up exhaust valves, stick rings, increase fuel consumption and give the maintenance man a headache. The only back pressure the gas in an engine cylinder is worried about is that obtaining just outside its front door, when it is about to dash out through the valve opening or port, as the case may be. It is of no concern that there may be high back pressure somewhere else in the system, just so the gas can get out in an efficient manner.

That brings us right down to the business of measuring back pressure. How is it done? It is very simple. All you have to do is to hook a manometer on the exhaust system, and there is the pressure read directly off a scale in inches of water, or mercury, as the case may be. If this gives the right answer, the job is said to be o. k. Oh yes, if it happens to read quite low, nobody bothers to inquire why. Engine builders are in the habit of specifying a maximum back pressure at the manifold of their engines. These requirements can be and are met. They also specify sometimes how much pressure drop may be tolerated through the silencer. To check this, a manometer is hooked in on both sides of the silencer and the reading taken. Now there is a little more to this business of measuring back pressure than meets the eye.

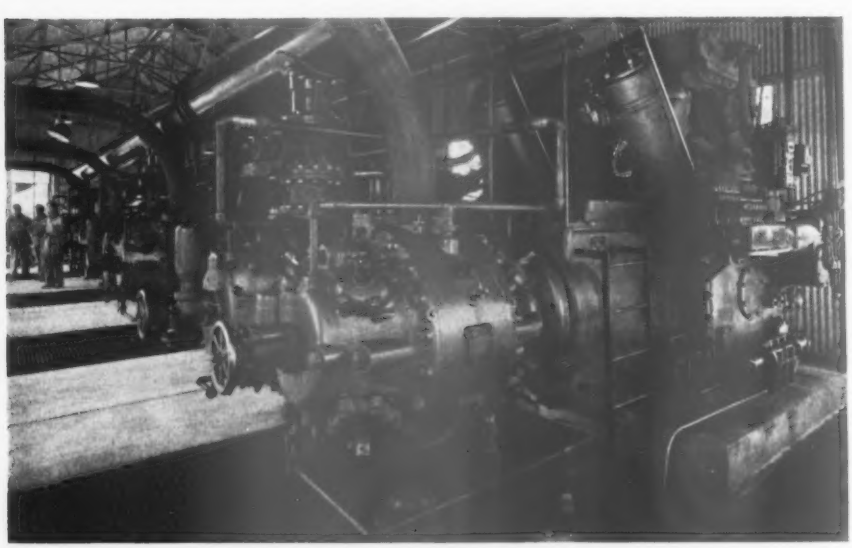
Where Errors Occur

In the first place, it is not too easy to tap into an exhaust pipe and lead off a connection to a manometer without incurring an error due to the velocity of the gas through the pipe. If a burr is left in the pipe when the drilling and tapping are done, the reading may be either high or low, depending on where the burr is and how big. On the upstream side of the hole, it may create a suction due to turbulence and the reading will be low. A burr on the downstream side will act as a scoop, and create a false pressure. Sometimes the connection is made on the outside of an elbow. A component of the gas velocity hits the open end of the tube and the gage reads too high.

Most engine exhaust systems are oscillatory in character. Some two-cycle gas and Diesel engines depend on exhaust tuning for efficient operation. It can be said that practically all exhaust gas and intake flow to reciprocating and rotary compressors is oscillatory in character. In addition, there may be heavy surges. We have seen manometers read negative pressure in an exhaust system running at full load.

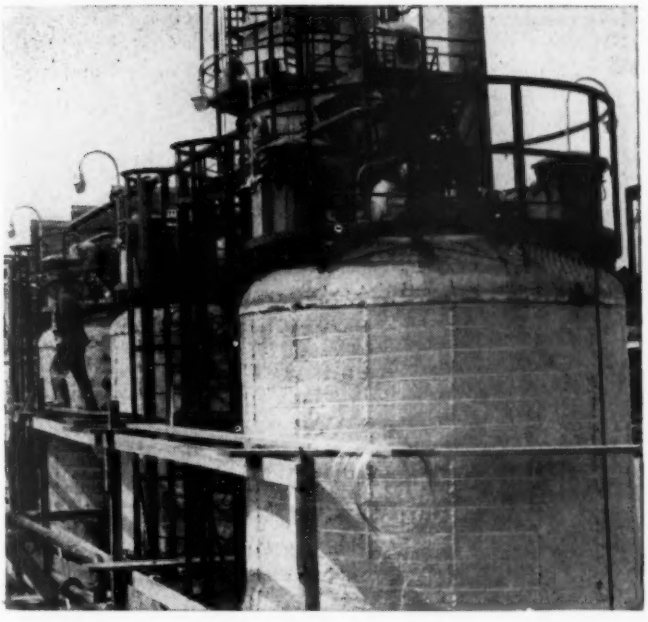
Surges travelling down the exhaust pipe will reflect from the end of the pipe and from a silencer and set up standing wave systems along the length of the system. The pattern of these standing waves can readily be ascertained by experiment, either with suitable electrical gear or with the manometer. But these wave patterns are similar to alternating currents. Sometimes their intensity is greater than the pressure due to steady flow. Under these conditions, how can a "direct current" instrument like a manometer be expected to register alternating current? Or at least an alternating pressure, superimposed upon a steady or D. C. pressure? The answer is—it can't.

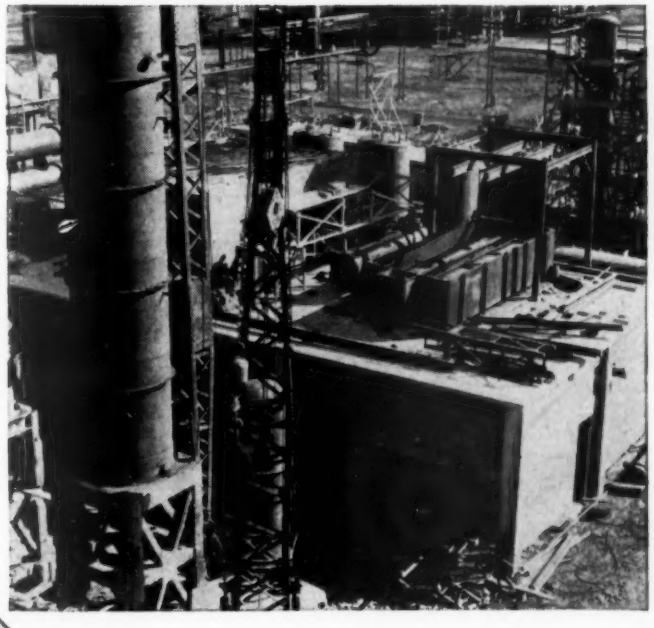
Some of you may be in a position to try an experiment in your plants. A succession of manometer readings, taken every foot along a fairly long exhaust pipe, will show that the apparent



A line of 4-cylinder compressor units in Shell Oil Co.'s East Cromwell plant at Wewoka, Okla. Each engine is rated 400 hp. (Photo from Cooper-Bessemer Corp.)

WHAT GOOD ARE PROMISES WITHOUT PERFORMANCE?





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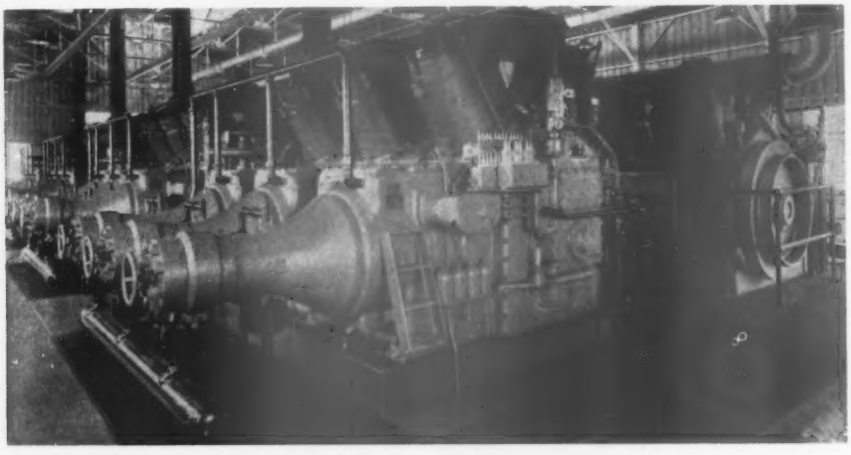


Part of an installation of 6-cylinder engine driven compressors in J. S. Abercrombie & Harrison Oil Co.'s pressure maintenance plant at Old Ocean Field, Texas. Each unit is rated 600 hp. at 300 rpm (Photo from Cooper-Bessemer Corp.)

pressure in the line is a variable with distance along the line. Allowing for a normal steady flow drop, the readings may follow a fairly good sine curve. The points of maximum pressure will be found to be where maximum changes of pressure in the standing wave system occur. The manometer will read lowest at points where the pressure changes are least and where the alternating acoustic velocity is highest. It may be said that exhaust systems involving high rates of gas flow suffer from this effect to a less degree than those of low rates of gas flow. In other words, the higher the resistance of an exhaust system, the less important is the standing wave system from the point of view of erroneous manometer readings.

Variations on Reading

Apart from this, there is another little gem to be taken into account. The length of the manometer tube may play tricks on the readings. Hook a manometer on the blank end of the exhaust manifold, where it will read about as high as anywhere in the system. Vary the length of the rubber tube connection and watch the reading go up and down, while the engine conditions remain constant. A maximum reading will be obtained when the distance from the manifold to the surface of the liquid in the manometer equals approximately 3400 divided by the number of explosions per second. Double this length and the reading will be minimum. These two readings may show a discrepancy of 30%. The amount of this discrepancy will vary with the position of the connection along the line.

Furthermore, when the manometer is hooked on near a point of high acoustic pressure change, like the dead end of the manifold, try pinching the rubber tube at various distances along its length. We can easily demonstrate both increases and decreases in readings depending upon just how we pinch the tube. There is no steady gas flow in the manometer tube—just pulsations, or standing waves of considerable intensity. Pinching the tube creates an acoustic rectifier. If the pulsations go toward the manometer more easily than the other way, the reading will be increased and vice versa. How much are these changes? Anywhere from 50% less to over 200% greater, and without really trying to make an efficient rectifier. The point of all this is that the very connection used to hook on the rubber tube may act as a rectifier and so give erroneous readings. In this case, the readings are generally too high. A petcock makes a pretty good rectifier, especially when partially closed.

We have made back pressure readings by the notebookful. It is a complicated piece of business to test a model silencer on steady air and then try to predict what it will do on an engine, to say nothing of an engine of 2000 hp. The exhaust gas analysis, temperature throughout the exhaust system, quantity of exhaust gas, size of the exhaust piping and its length must be known if accurate calculations are to be made. Actually, we have considerable information taken in the field to help out, so that we generally know pretty well what the back pressure is going to be. We even think we can guess it within 10%. In the laboratory, with luck, we can predict it much more accurately. But to walk up to a silencer in any old exhaust system on any kind of engine, running at a guessed-at load, and say what the back pressure is going to be does not come into the realm of precise determinations. An engine manifold is anything but a clean-cut acoustic system, what with valves popping open and shut up and down the line. The terrific temperature gradients, both with respect to time and distance, also add a few complications.

How Silencers Work

Now let's talk about silencers themselves and how they work. Conditions in the field vary so greatly that not only a number of different sizes are called for, but also several different types. Special installation considerations also add to the list. One way of classifying silencers is to call them absorbers, filters, or preventers, or combinations of these three.

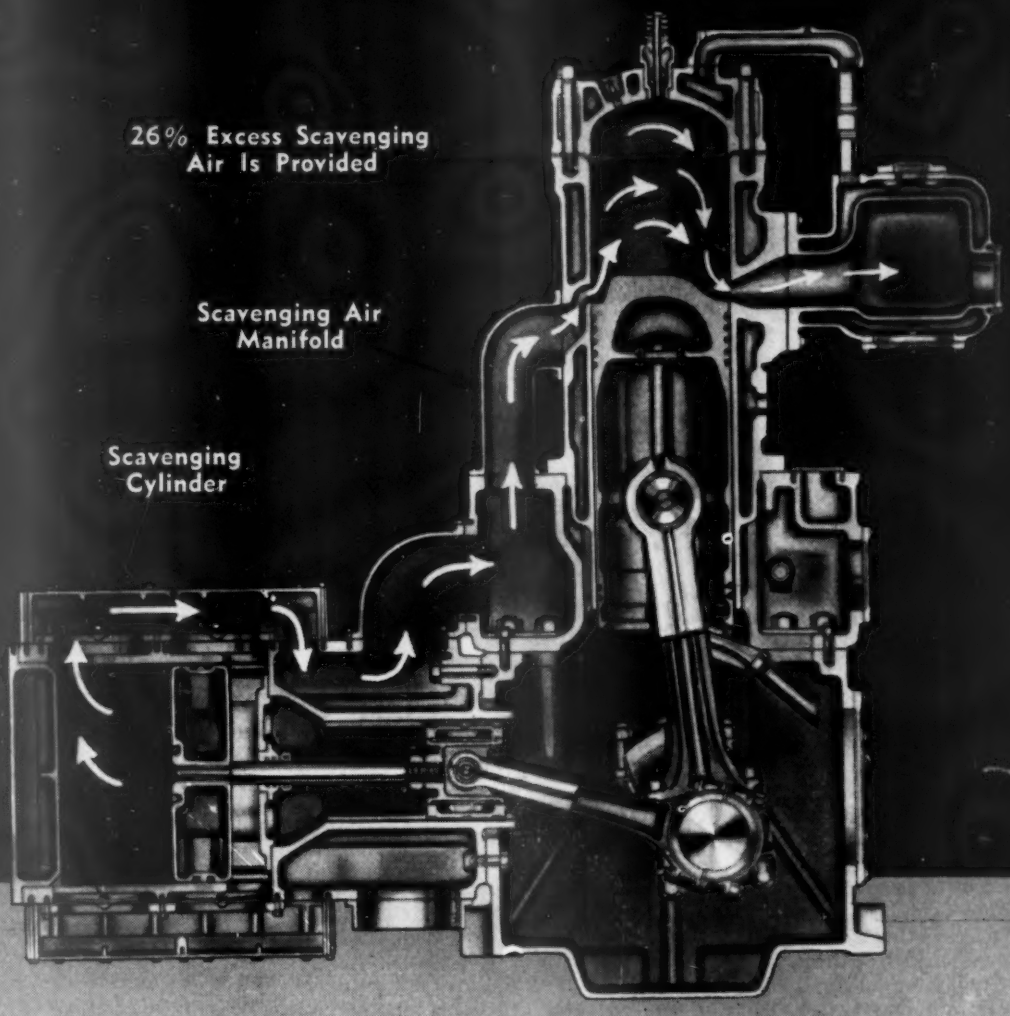
The absorber type makes use of fibrous material like rock wool, steel wool, and other sound absorbing stuff. It works by dissipating the sound waves in minute channels and by losses incurred by inelastic bending. The material is disposed alongside the duct carrying the gases and sound. A perforated steel tube is generally surrounded with a thick layer, backed by an impervious containing shell. These silencers are effective on high frequency sounds travelling along in clean gas. They fill up with carbon deposits in a few days on a dirty exhaust. They also are prone to break up into dust under the stress of vibration.

The filter type operate on the principle of acoustic interference. Resonance chambers may be disposed along the main gas passage, in a number of different ways, depending on just what the problem of silencing is. Acoustic filters may be designed to cover a very large range of sound frequencies. They are not particularly good on high frequencies, at least in commercial exhaust pipe sizes. Any desired degree of noise reduction can be obtained by their use, without imposing any particular degree of back pressure, since the conduit is generally straight through, with no obstructions whatever. Another type of acoustic filter is the old familiar expansion tank. This gives wide frequency coverage, but not a great deal of attenuation unless the tank is made quite large. Two large tanks of different size can do a pretty good job of silencing.

Preventer Type Silencer

The modern trend in silencer design is the preventer type. Perhaps we had better call this a "breaker-up-er". The gas surges coming from the engine or the surges in a compressor intake hit the silencer and are smoothed out so that they are incapable of creating sounds when they hit the open air. Furthermore, the sounds already present in the exhaust pipe are attenuated by the arrangement of chambers and tubes comprising the silencer. The acoustic system comprising the silencer itself is designed so that it cannot be shock excited into creating new sounds. Improperly designed silencers can operate as actual amplifiers for certain frequencies.

A certain independence of pipe length is enjoyed by this type, but it by no means can be placed anywhere in a sensitive, tuned, engine exhaust system. It does render the tail pipe length less critical, in most cases. This general



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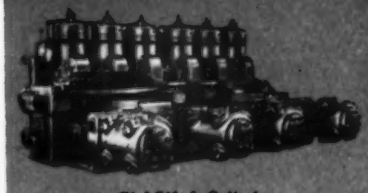

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type performs so well on such a wide variety of jobs, that we call it a "universal" type. It works equally well on compressor intakes and exhausts and engine intakes and exhausts. Its design is such that any number of units may be placed in series, to give any possible required degree of noise reduction. Ordinarily two sections are used. For supersilencing, we use three. It has only once in our experience been found necessary to use 4 sections and in this case the exhaust had to be inaudible at a distance of 5 feet from the end of the exhaust pipe. To guard against shell noise, the entire silencer is made of laminated construction. Two contiguous metal surfaces, not too closely joined, set as a high acoustic resistance, and prevent shell ringing. It's like holding a bell in the hands. It won't ring very well when struck. This type is also very effective in stopping tank hammer in air receivers.

Another special type combines the sound absorber type with the filter type and gives very high attenuation on certain intake systems, such as positive pressure blowers. It has extremely low back pressure, but cannot be used on exhaust systems. It finds application on steam discharges and the like.

The universal type has been combined with other useful features in the internal combustion engine field. Its principles are used in spark arresting silencers of various types, designed to meet the needs of the trade. Sometimes the cooling water is introduced into the silencer for spark arresting and extra silencing. It finds application also in heat recovery silencers which save most of the heat otherwise thrown away. An extra degree of silencing results from the sudden chilling of the exhaust gases.

Theory of Connection

Two-cylinder gas engines of the two-cycle type are generally Y connected to a silencer. The theory of this type connection has been worked out and the results in the field have been gratifying. In fact, more power can be obtained from a two-cylinder, two-cycle gas or gasoline engine when it is Y connected with the proper lengths of pipe than can be obtained with separate exhaust pipes for each cylinder. What is wanted, is to slightly supercharge the cylinder with scavenging air that has been blown through the cylinder and then partially forced back by the wave action, just so the port or valve closes. Oscillograms taken under conditions of maximum output verify this.

What is not wanted in a tuned engine exhaust system is resonance. A single cylinder, two-cycle engine, has great difficulty in even running at all, with just the wrong length of pipe. It is very liable to four-cycle automatically, instead. The magic length is in the neighborhood of one sixteenth wave length. To reduce this to feet, first find the velocity of sound in the exhaust pipe by multiplying 49 by the square root of the absolute temperature of the exhaust pipe, averaged over its length. This answer is in feet per second. Divide this velocity by 16 times the revolutions per second, and place the silencer with that length in feet between it and the port of the engine.

A silencer placed at the correct distance from the port will not rob the engine of any appreciable amount of power. On the contrary, it is easy to demonstrate that a silencer placed in the line at what would be a wrong length without it, will actually increase the power output. And what is the back pressure, under optimum running conditions, for one of these sensitive engines? I don't imagine the engineer cares very much because he is getting maximum power, minimum temperatures and a sweet running job. Years ago, we knew of an installation that was giving trouble because of high cylinder temperatures—yet the back pressure at the silencer was only a half inch of water. Had the back pressure been taken about 10 feet nearer the engine, it probably would have been sky high.

On four-cycle engines, the position of the silencer is not so important. Placing it an odd number of quarter waves from the center of the manifold, and using a quarter wave long tail pipe seems to yield the lowest back pressure as well as the highest degree of noise reduction. Sometimes, it is not possible to use a quarter wave long tail pipe, as in the case of high speed multi-cylinder engines of considerable size. A quarter wave tail pipe might turn out to be not much greater than the diameter of the pipe. In such cases the tail pipe must be longer. Some odd number of quarter waves will be best, but most any reasonable length will be O.K. We can't hit these spots as well in the field as in the laboratory, of course. It is hoped that the information presented may be of some practical use. If the engineers making the plant layouts were cognizant of some of these facts, it is possible that many installations would benefit thereby.

Sample Hydrocarbons Are Now Available

IN ACCORDANCE with the announcement made June 1, 1943 by Dr. Lyman J. Briggs, director, work was begun at the National Bureau of Standards July 1, on the preparation of standard samples of hydrocarbons of known high purity for calibrating analytical instruments and apparatus in the research, development, and analytical laboratories of the petroleum, rubber, and allied industries.

In order to expedite the work, and to make available the largest possible number of compounds in the shortest time, only a limited quantity of each hydrocarbon has been prepared and the purity of each has been pushed only to a point that is believed to be amply adequate for the present urgent needs for calibration.

There are now available under this program 15 hydrocarbons, as follows:

Compound	NBS Standard Sample No.	Amount of impurity Mole, %
n-Pentane	201	0.25 ±0.10
2-Methylbutane (isopentane)	202	0.13 ±0.06
n-Hexane	203	0.24 ±0.09
2-Methylpentane	204	0.25 ±0.10
3-Methylpentane	205	*
2,2-Dimethylbutane	206	0.12 ±0.05
2,3-Dimethylbutane	207	0.06 ±0.04
Methylcyclopentane	208	0.25 ±0.09
Cyclohexane	209	0.012 ±0.007
Benzene	210	0.05 ±0.02
Methylbenzene (toluene)	211	0.04 ±0.02
Ethylbenzene	212	0.20 ±0.07
1,2-Dimethylbenzene (o-xylene)	213	0.14 ±0.05
1,3-Dimethylbenzene (m-xylene)	214	0.17 ±0.07
1,4-Dimethylbenzene (p-xylene)	215	0.07 ±0.03

*Not determined; believed to be the same as for 2-methylpentane.

Each of these hydrocarbons is available at the costs shown below in Pyrex glass ampoules, sealed "in vacuo", in the following kinds and sizes of containers: In volumes of 5 ml (designation to follow standard sample number -5) plain ampoule, sealed "in vacuo", $3 per sample; in 8 ml volume, (designation -8S) special ampoule, with internal vacuum "break-off" tip, sealed "in vacuo", $5; in 25 ml volume, (designation -25) plain ampoule, sealed "in vacuo", $9.

Proper designation is illustrated as follows: An order for 8 ml of cyclohexane, sealed "in vacuo" in a special Pyrex glass ampoule with internal vacuum "break-off" tip, would be given as "Cyclohexane, No. 209-88. Similarly, an order for 5 ml of 2,2-dimethylbutane, sealed "in vacuo" in a plain Pyrex glass ampoule, would be given as "2,2-Dimethylbutane, No. 206-5.

For simplification the cost of the various hydrocarbons has been made the same. Prices are subject to change as conditions warrant. The cost includes delivery under government frank in the U. S. and to Mexico, Canada, Cuba, and U. S. possessions. For all shipments to other countries, 50 cents postage must be added for each container, and, in addition, 25 cents for insurance or registration of each shipment.

Samples must be paid for in advance, with order. Money orders, checks, etc., should be made payable to the National Bureau of Standards. Payment for foreign orders should be by an international money order or by a check payable through the New York Clearing House or a bank in the U. S.

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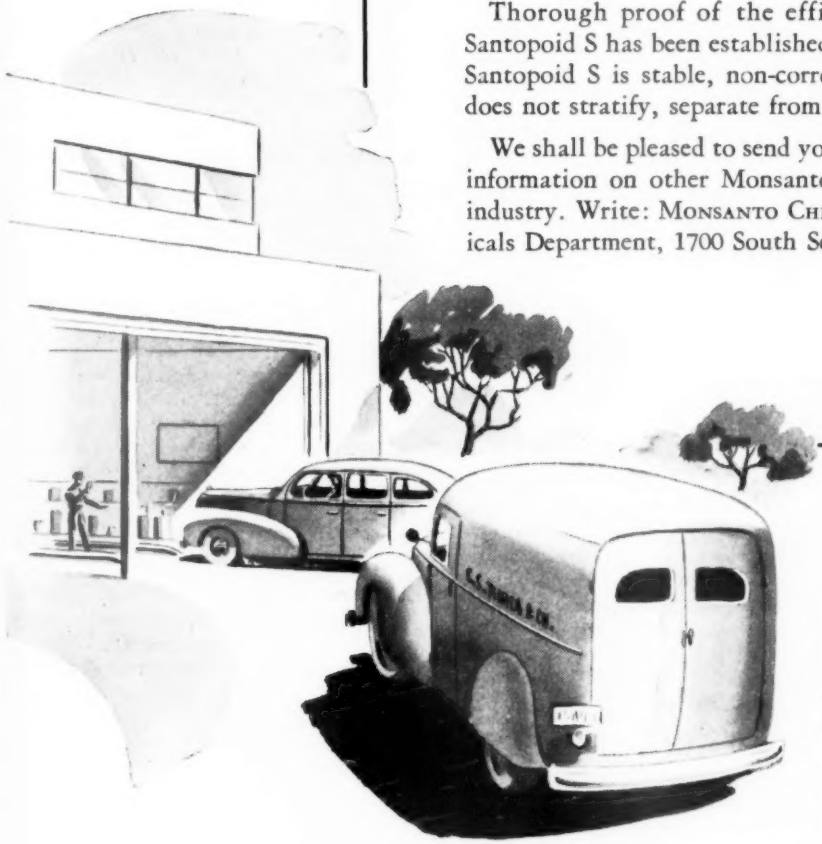

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The extent of these accomplishments in the testing and utilization of synthetic rubbers was evidenced at the symposium on "The Applications of Synthetic Rubbers" held in Cincinnati March 2 under the auspices of the American Society for Testing Materials.

Several hundred rubber technologists and others who attended to learn the latest advances in the field of synthetic rubbers were told how physical properties of the various synthetics compare, what new test methods are used, and that a standard system for noting specifications for synthetics and natural rubbers has been developed.

The extent of present commercial use of synthetics for tires, tubes, molded products, footwear, adhesives, and other items was discussed. In every instance the speakers predicted further improvements in the manufacture and larger utilization of the synthetic products.

Of most general interest and importance to the petroleum industry was the discussion on synthetic rubber tires and inner tubes, with charts showing the various operating characteristics of synthetic and natural rubber tires. Portions of this paper are presented below, together with brief abstracts from other papers on the applications for the synthetic rubbers.

Complete data comparing the principal synthetic rubbers in use today with each other and with the natural rubber as to physical properties were given in another paper. An abstract of this paper, "Physical Properties of Synthetic Rubbers", is also presented in this issue.

Synthetic Rubber Tires and Inner Tubes*

*By P. M. Torrance***

IT HAS BEEN approximately three years since the synthetic rubber most suitable for tire manufacture—GR-S, or Buna S—became available in sufficient quantities for experimental work on a factory scale. The major rubber companies had made and tested experimental synthetic tires previously, but in the fall of 1940 they rolled up their sleeves and began such testing work in a big way. At that time, we were all preparing to use synthetic rubbers in large quantities to supplement and extend our natural rubber supply, but it was not until after Pearl Harbor and the subsequent fall of Singapore and the Dutch East Indies that anyone realized we were faced with practically complete replacement of natural rubber by synthetics.

The synthetic rubber passenger-car tire is today a satisfactory product. At reasonable speeds it will deliver performance almost equal to the best prewar tire. The small civilian truck tires are reasonably satisfactory for use on light trucks, although their relative performance drops rapidly with extreme overloads.

The great majority of Army truck tires fall in the small size group, and may be expected to give reasonable performance, because generally speaking they are not overloaded. Tread design, which is a most serious problem in highway tires, is not serious in Army tires due to the non-directional cross bar design, which minimizes this type of failure, and due to Army tires not being overloaded nearly as much as highway tires. The larger truck tires, 8.25 section and up, are still a most serious problem.

Fig. 1*** shows the operating temperature of a 9.00-20 70% synthetic rubber truck tire compared with a similar natural rubber tire at several truck loading conditions. It will be noted that temperature difference is large, and becomes greater with increasing overload. Also, the temperature of the synthetic rubber tire at rated load is approximately equal to that of the natural rubber tire at 30% overload. A large number of tests have shown that the total mileage expectancy of these synthetic rubber tires is increased threefold when loads are dropped to Tire and Rim Assn. standard from 30% overload.

Figs. 2 and 3 show to what extent the tear resistance and tensile strength of both natural and synthetic rubber tread compounds are reduced at elevated temperatures.

Excess Heat Still Problem

This excess heat is one of the biggest problems of tire manufacturers. It causes premature fabric breaks and blowouts of synthetic rubber tires. It also aggravates the other great weakness of synthetic rubber, namely, its lower tear resistance, which causes excess cracking or splitting when a cut or other injury breaks the tread surface.

One solution to the problem of excess heat is the use of rayon fabric in place of cotton. Rayon not only reduces the tire temperature, but is also better able to withstand the higher temperatures. Fig. 4 shows the operating temperature of a 7.50-20 90% synthetic rubber Army tire made with cotton compared to the same size tire made with rayon and also to a natural rubber tire made with cotton. It will be noted that the rayon reduces the running temperature of the synthetic rubber tire, making it equal to or lower than natural rubber.

Fig. 5 shows the operating temperature of a 9.00-20 rubber cotton tire compared with the same tire made with rayon. It will be noted that here again rayon reduces temperatures and greatly increases mileage.

Sufficient high tenacity rayon has been made available for large Army tires, for inter-city bus tires, and for the larger sizes of truck tires that operate under severe conditions. There is further expansion in progress, and rayon is now becoming available at such a rate that it is going hand-in-hand with the synthetic rubber conversion program, so that all large synthetic rubber truck tires can be made of rayon in order to give maximum service.

Tubes Fairly Satisfactory

Extreme overloads and high speeds, particularly common in present day intercity trucking operations, must be eliminated in order to operate successfully on synthetic rubber tires. In the meantime, we are doing everything possible to improve synthetic tires.

GR-S inner tubes are reasonably satisfactory, except for the smaller sizes used on drop center rims where the high well stretch causes many premature failures. There are indications that tubes for drop center rims may be improved through the use of other synthetics, particularly Butyl rubber. The largest sizes have not yet been adequately tested for evaluation.

Good progress has been made in the use of GR-S in solid tires. This is true not only of commercial solid tires but also of the bogie rollers and rubber tank tracks that are used on military equipment and which operate under the most severe conditions of any solid tire

*Abstracted from an article of the same title presented at the A.S.T.M. Rubber Symposium in Cincinnati, March 2, 1944.

**Manager of General Laboratory, The Firestone Tire & Rubber Co.

***Numbers of figures referred to here do not in all cases correspond to numbers in original text.

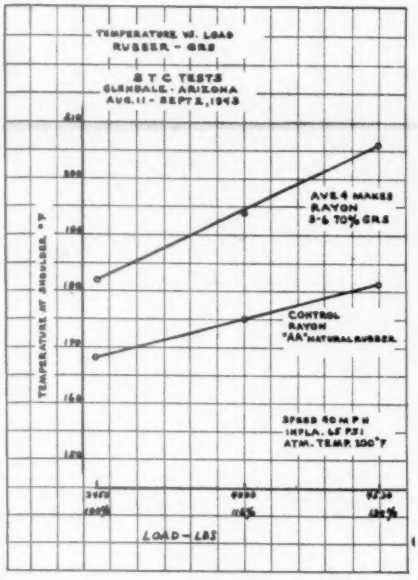

Fig. 1—Operating temperatures of both synthetic and natural rubber tires increase with overload — but synthetic more rapidly. Top curve shows temperatures for 9.00-20 truck tire containing 70% GR-S, running from 100% load to 130% load. Lower curve shows temperatures for same size 100% natural rubber tire operating under same conditions. Operating temperature of synthetic tire at rated load is about equal to that of natural rubber tire at 30% overload

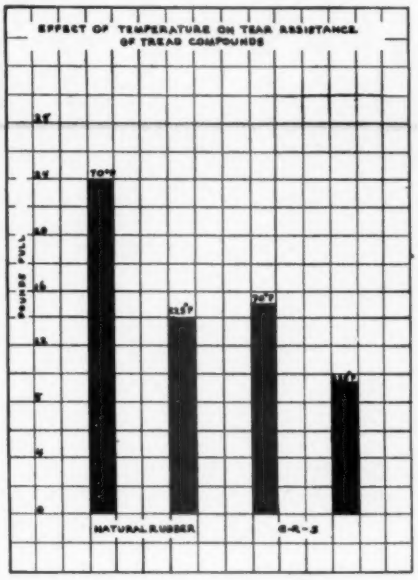

Fig. 2—Higher temperatures reduce tear resistance of both synthetic and natural rubber tread compounds

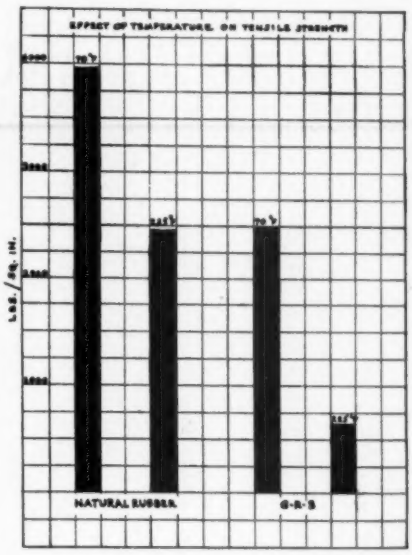

Fig. 3—Tensile strength of GR-S drops more rapidly than that of natural rubber as temperature increases

type product. The properties of GR-S appear to lend themselves better to replacing natural rubber in such solid tire applications. The Army has done extensive testing, and reasonable performance relative to natural rubber can be expected.

Large Scale Road Tests

Much has been done in the way of actual road testing of synthetic tires under different conditions. In June, 1942, the Army Ordnance Department began large scale testing of synthetic tires at Camp Normoyle, Texas, and Camp Seeley, Calif., constituting the largest tire testing operations in history. In the Camp Normoyle operations alone more than 500 people are employed and more than 70 test vehicles are in active service.

In August, 1942, the SAE Ordnance Advisory Committee expanded its Rubber Product Subcommittee into several sub-groups, one of which is the Pneumatic Tire Subcommittee. Through it the various rubber companies and the Ordnance Department have co-operated to exchange information on synthetic rubber tires and plan tests for these Army operations.

In December, 1942, a committee of chemists and engineers, known as the Synthetic Tire Construction Committee, was formed by the tire companies and the Office of Rubber Director to correlate all development of synthetic rubber tires for both civilian and military use. Since May, 1943, this group has operated a fleet of 26 large commercial trucks at Phoenix, Ariz., testing 9.00-20 tires. There is complete exchange of information and excellent co-operation so that rapid progress is being made in the development of civilian truck tires.

In May, 1943, a second large fleet of trucks, known as the Government Test Fleet, was also started testing civilian highway truck tires. This is financed by the Rubber Reserve Co., and operated for the Office of Rubber Director by the Copolymer Corp., which in turn is owned by a group of smaller manufacturers. This fleet also has three passenger cars which are being used to evaluate smaller tires.

Several years ago Buna S synthetic rubber required considerably increased milling times as compared to natural rubber, and also processed more slowly in other operations. This property would have been a most serious handicap because it would greatly reduce the capacities of our tire factories. Co-operative effort has produced softer GR-S and also improved methods of handling as well as improved compounds. At the present time, the overall average drop in ca-

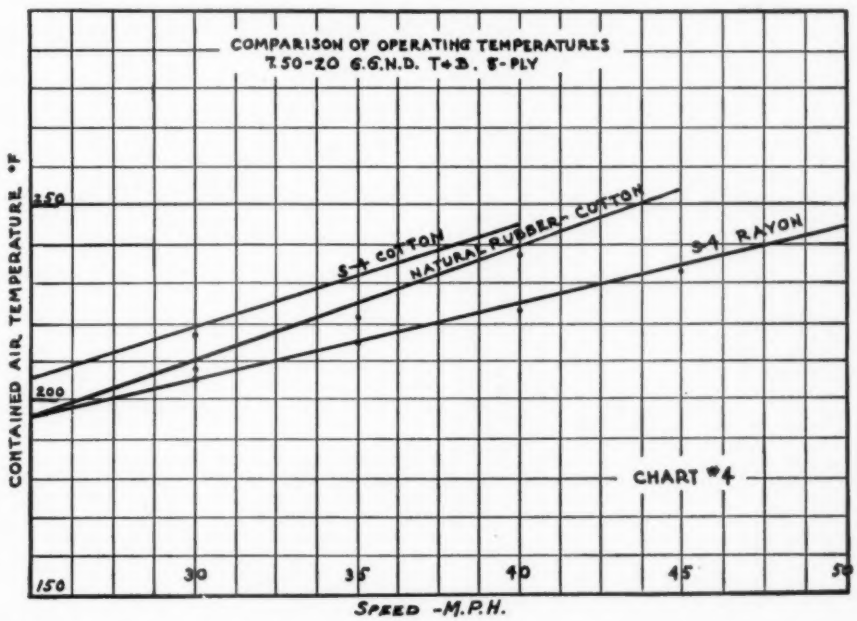

Fig. 4—Use of rayon fiber reduces running temperature of synthetic rubber tire, making it equal to or lower than natural rubber. The operating temperature of a 7.50-20 90% synthetic rubber Army tire made with cotton (top curve) is compared to that of the same size tire made with rayon (bottom curve) and also with a natural rubber tire made with cotton (middle curve)

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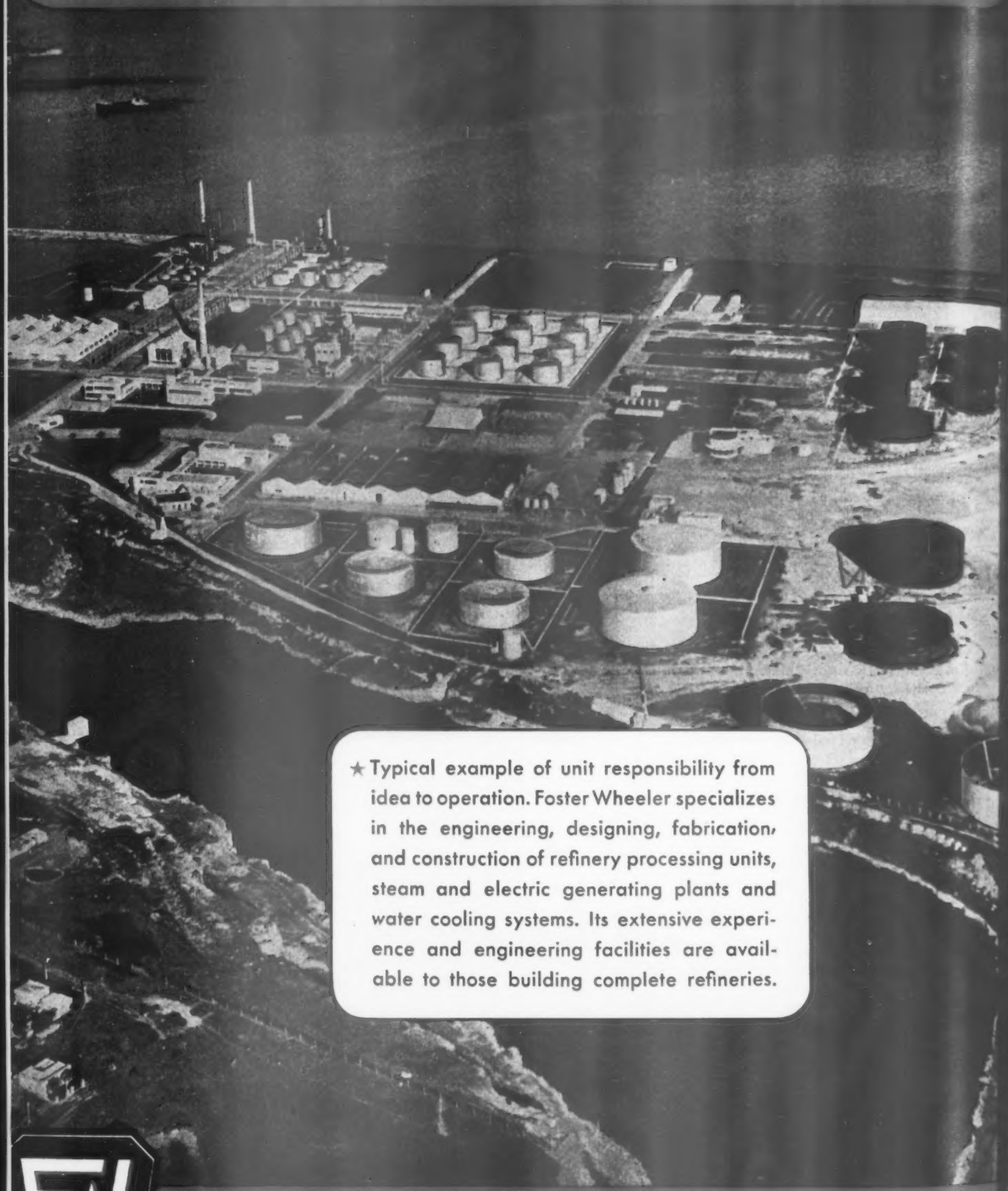

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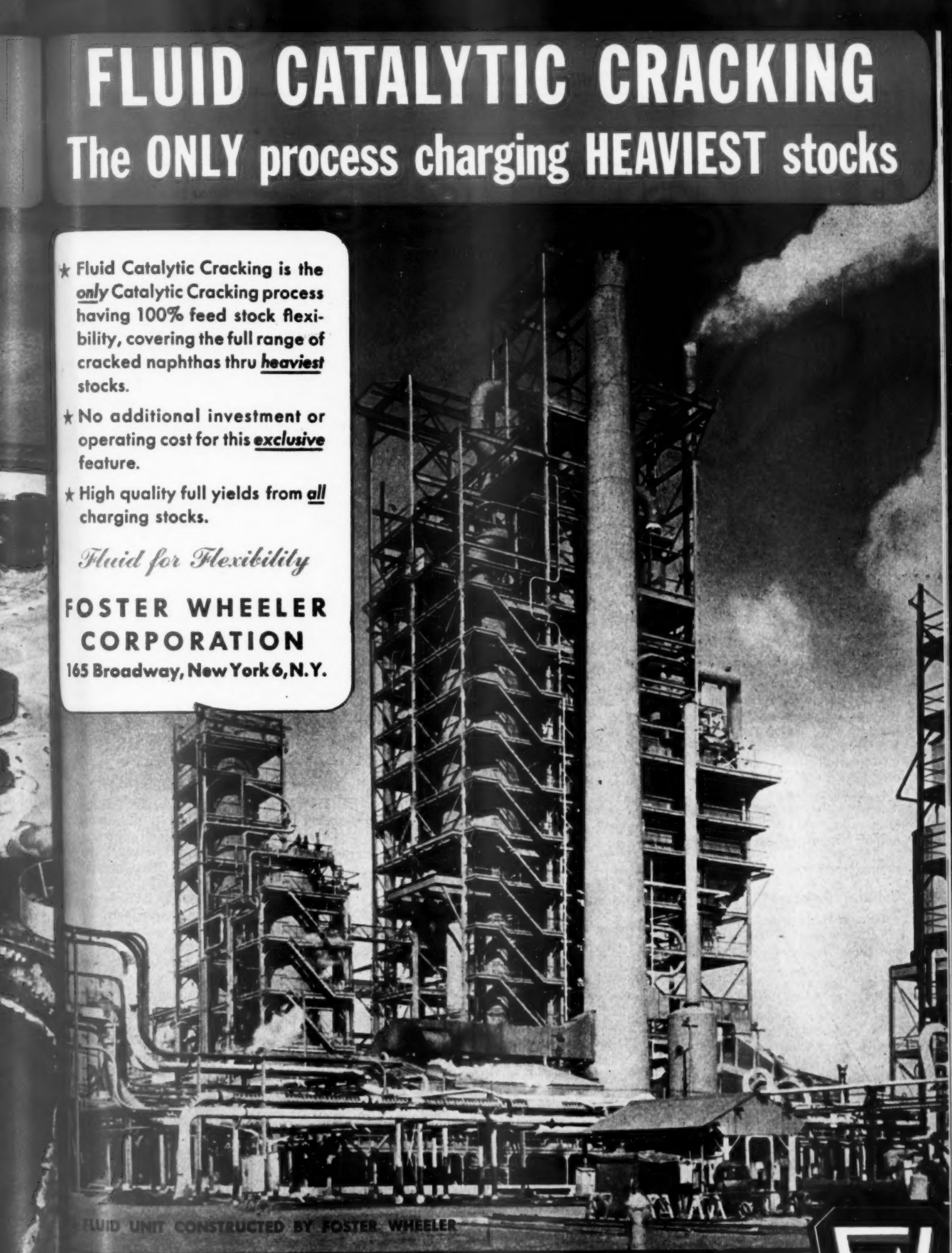

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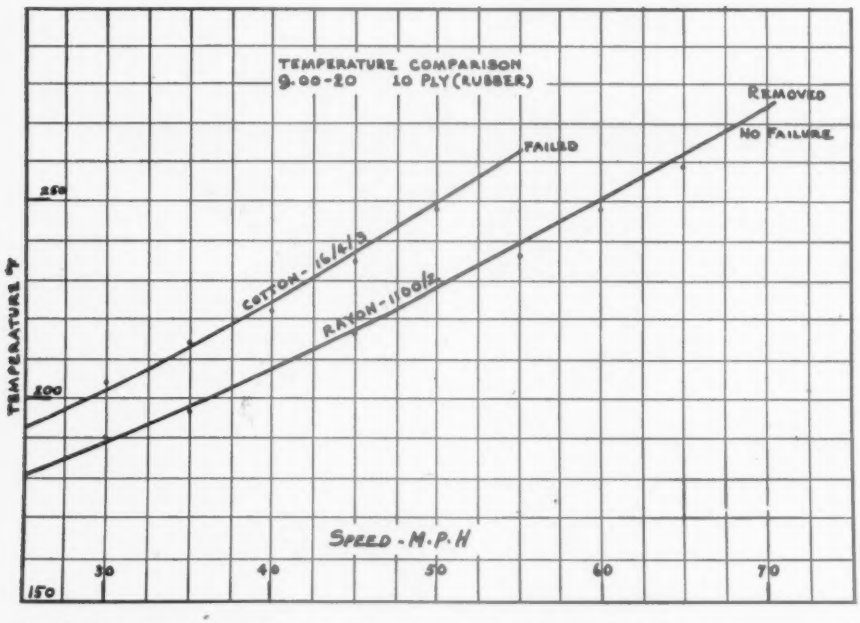

Fig. 5—Use of rayon fabric in place of cotton reduces running temperature and greatly increases life of even 100% natural rubber tires at high speeds. Above chart indicates failure of 9.00-20 10-ply natural rubber tire made with cotton at 55 mph. Same size tire made with ravon didn't fail even at speeds in excess of 70 mph

pacity is not over 20%—and is probably somewhat less. Additional facilities are being provided so that our rubber factories will be able to process all of the rubber required.

Looking into the future, the prediction is made that chemical research will produce much better synthetic rubbers. It is even probable that they will surpass natural rubber in other properties as they have already surpassed natural rubber in oil resistance. There is no good reason to believe that Mother Nature, in creating the natural latex of the rubber tree, designed the best possible material for tread wear, heat generation, and other characteristics.

There are numerous examples of man-made synthetics created for specific purposes which have far surpassed the natural materials previously used. In our own tire industry we have high tenacity rayon fibers, which give results vastly superior to natural cotton fibers. At the present time, Nylon fibers give every indication of doing a still better job. Given sufficient time, there is every reason to believe that synthetic rubbers will be created vastly superior to the present materials.

Cellular Rubbers*

Cellular rubbers are divided according to cell structure of the finished product into three classes: Class 1—Multi-cellular, with open cell structure (sponge rubber and latex foam rubber fall in this class); Class 2—Uni-cellular, with closed cell structure (expanded rubber); and Class 3—Micro-cellular, with cells too small to be readily visible to the naked eye.

Sponge rubber products are being made today from almost all of the various types of synthetic rubbers. General purpose items are usually made from either Buna S or from Neoprene GN. Buna N is ordinarily used only in applications where extremely low swelling in petroleum base oils is necessary.

Sponge rubber made from Neoprene GN was originally used only where medium low swelling in petroleum base oils was necessary. However, since the advent of the war, Neoprene GN (GR-M) has been used to make sponge rubber for a wide variety of general uses.

Oil resistance of sponge rubbers unless covered with an added synthetic rubber skin is not so great as the resistance of the corresponding polymer molded solid. However, although the volume change is higher than on solid rubbers, the pieces retain considerable strength and do not disintegrate in petroleum base oils as do sponge rubbers made from natural rubber.

Hard synthetic (ebonite) sponge rubber is being made from Buna S and Buna N. These products are very similar to those made from natural rubber and in some properties, notably tensile and impact strength, are even superior.

In the field of latex foam rubber good results have been obtained with Neoprene GN. Aging properties as measured by the oxygen bomb are excellent and resistance to oil is superior to that of products made from natural rubber latex. Unfavorable properties are the shrinkage which is approximately twice that of natural rubber latex, poor freeze resistance in the unplasticized state, and only slight improvement when freeze resistance plasticizers are added. The permanent set is greater than in natural rubber latex sponge, but it is believed that this can be improved. The flame resistance of all types of Neoprene latex foam is especially important in the case of truck cushions, car and bus upholstery and airplane cushions, where serious accidents have occurred due to the flammability of latex foam made from natural rubber.

In the field of expanded rubbers, good products have been made from Butyl (GR-I), Neoprene GN (GR-M), Buna N, and Buna S (GR-S). Neoprene GN and Butyl rubber give the best soft expanded rubber due to their relative impermeability to gases. Where resistance to aviation fuels is required, Buna N is used. For water resistance, Butyl, Buna S, and Buna N are satisfactory but Neoprene GN is poor. For resistance to light aging and weathering, experience would indicate that Buna N is better than Neoprene.

Many difficulties in the cellular rubber field have been due to variability in the plasticity and in the rate of cure of different lots of natural rubbers and in the stability and rate of cure of different shipments of natural rubber latices. We hope that these difficulties will be overcome in the man-made product.

*Abstracted from a paper of the same title by Louis P. Gould, Inland Mfg. Div., General Motors Corp., presented at the A.S.T.M. Rubber Symposium in Cincinnati, March 2.

Synthetic Rubber Adhesives*

Synthetic elastomers are successfully being used in many cases as substitutes for crude and reclaimed natural rubber in the making of adhesives. However, if the user insists on exactly the same properties that he has been in the habit of obtaining from crude and reclaimed rubber, the adhesive manufacturer's efforts may not always meet with success.

Of the synthetics evaluated, GR-M (Neoprene GN) gives adhesives having properties most nearly comparable to those obtained with crude rubber. When properly compounded and handled, Neoprene adhesives are being used in many places where reclaimed and crude rubber adhesives were formerly employed. However, adhesives made from certain modified Buna-S materials have been found to be more nearly comparable to the reclaimed rubber type of materials.

Adhesives have been produced using Thiokol as a base, although this material has many properties which make it undesirable for adhesive compounding. Where the maximum of solvent resistance is needed, however, adhesive can be

*Abstracted from a paper of the same title by Fred Wehmer, Products Manager, Adhesive Division, Minnesota Mining and Mfg. Co., Detroit, Mich., presented at the A.S.T.M. Rubber Symposium in Cincinnati, March 2.

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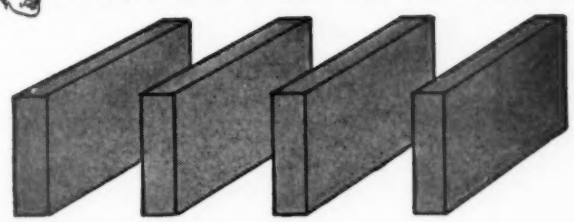

JM-1620	JM-20	JM-23	JM-26
Fireblok—for exposed temp.' to 1600° F. As back-up to 2000° F.	Fireblok—for use up to 2000° F. Exposed or back-up	Fireblok—for use up to 2300° F. Exposed or back-up	Fireblok—for use up to 2600° F. Exposed or back-up

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made from Thiokol which do a good job. But they require special compounding, and since the solvents used are toxic and the working range is short, they usually also require special application technique.

Concerning the use of these adhesives made from synthetic rubbers when crude and reclaimed natural rubbers are again available, it is believed that many of them will remain in use because of their unique properties, such as unusual strength, resistance to oils and solvents, and the like.

Molded Products*

In the conversion program on molded products we have been constantly up against the necessity of changing from one material to another without sacrifice of quality and without appreciable loss of production.

Despite new processing problems and limitations in compounding, we are now producing molded items almost equal in quality to those made from natural rubber. By changes in compounding it has been possible to develop good quality medium-soft GR-S compounds, resilient GR-M compounds, and quite satisfactory stocks from both synthetics for moderately low temperature service. Under proper conditions, entirely satisfactory metal to rubber adhesion can be obtained with synthetics in molded products.

Special purpose synthetic rubbers, such as Hycar OR-15, Hycar OR-25, Perbunan, Chemigum, and the Butaprenes and Neoprenes, are already firmly established in such parts as seals, diaphragms, gaskets, boots and countless other parts where any of the conditions requiring their special properties exist.

When synthetic rubbers are used in the applications best suited for them they unquestionably will give entirely satisfactory service; in fact, under certain conditions an improvement in service life will result when they are substituted for natural rubber. In applications where exceptional resistance to age, heat, weather or ozone, flame and oil are important, the synthetic rubbers will continue to be preferred when natural rubber is again available.

*Abstracted from a paper of the title "Use of Synthetic Rubbers in Molded Products" by Merle Sanger, The General Tire and Rubber Co., presented at the A.S.T.M. Rubber Symposium in Cincinnati, March 2.

Physical Properties of Synthetic Rubbers*

By J. M. Ball** and G. C. Maassen**

NO ONE synthetic rubber possesses as many good properties as does natural rubber, although each of them is superior in one or more respects to the natural material. Up to the present time, however, very little specific information has been made available regarding the various properties of the synthetics.

The purpose of this article is to compare the main synthetic rubbers in use today with each other and with natural rubber, as regards physical properties. In most cases the comparisons are made with the properties of vulcanized compounds, although in some instances the properties of gum stocks are compared. Only those synthetics used in large tonnages are included, and only those properties important to users of rubber goods are discussed. The aim is to show the good properties as well as the limitations of each kind of rubber, as indicated by laboratory data.

Only six main synthetics are compared —three general purpose and three special purpose ones, although all manufacturers have numerous specialty types available, designed to meet special requirements such as cold flow, swell or cold resistance.

General purpose synthetics discussed: *GR-S* (Buna S), Butadiene-Styrene Copolymer. *GR-M* (Neoprene), Polychloroprene. *GR-I* (Butyl), Isobutylene-Isoprene Copolymer.

Special purpose synthetics discussed: *Buna N, H.A.* ("H.A." means "high acrylonitrile content", as typified by Hycar OR-15). *Buna N. L.A.* ("L.A." means "low acrylonitrile content", as typified by Perbunan). Both types of Buna N are Butadiene-Acrylonitrile Copolymers. *Thiokol FA,* Organic Polysulfide Copolymer.

Some of the data in the tables are given in absolute units, some as percentages of the rubber values, which are taken as 100. Some tables also show qualitative ratings by use of letters A, B, C. The attempt has been to be as definite as possible, but to avoid a precision not justified by the data.

Percentage ratings are always given in the same order; that is, a high rating signifies high quality with respect to a given property, and a low rating signifies a low quality. Some ratings, therefore, like those for tensile strength, represent direct ratios as compared to the rubber value; other ratings, like those for swelling in oil, represent inverse ratios.

In view of the diversity of the compounds and test methods used by various workers, and because some synthetics are only now becoming standardized in quality, the data as a whole are far from being scientifically comparative or complete. No attempt is made to correlate the laboratory data on physical properties with service life of actual commercial rubber articles. Neither is there any implication that the exact absolute values reported will be obtained on commercial rubber goods.

In order to obtain reliable comparisons the data were selected whenever possible from results on laboratory test compounds rather than from results on commercial compounds. The channel black stocks referred to in many tables contain equal volumes of filler. This volume depends upon the specific gravity of the elastomer, and corresponds to that of 50 parts by weight of black per 100 parts by weight of natural rubber.

*The information in this article was obtained from a paper entitled "The Physical Properties of the Synthetic Rubbers", presented before the spring meeting of the American Society for Testing Materials, Cincinnati, March 2, 1944, as part of a symposium on "The Applications of Synthetic Rubbers."

**R. T. Vanderbilt Co., East Norwalk, Conn.

Tensile Properties

Only two of the synthetics, GR-M and GR-I, have satisfactory tensile properties as gum stocks, as shown in Table 1. The other synthetics must be compounded with suitable fillers such as carbon black for good tensile strength (Table 2). Comparison of the figures in Table 1 with those in Table 2 shows how synthetics having poor tensile properties as gum stocks have vastly improved tensile properties when compounded with channel black. The tensile strength of natural rubber is increased by the addition of channel black, although the tensiles of GR-M and GR-I, previously high, ordinarily are not.

Table 1***
(Tensile Properties, Gum Stocks)

	Tensile Str'gth P.S.I.	Elongation Per Cent
Natural Rubber	2500-3500	750-850
GR-S	200- 300	400-600
GR-M	3000-4000	800-900
GR-I	2500-3000	750-950
Buna N, H.A.	600- 900	500-700
Buna N, L.A.	500- 800	450-650
Thiokol FA	100- 200	450-550

Table 2
(Tensile Properties, Channel Black Stocks)

	Tensile Str'gth P.S.I.	Elongation Per Cent
Natural Rubber	3500-4500	550-650
GR-S	2500-3500	500-600
GR-M	3000-3500	500-600
GR-I	2500-3000	650-850
Buna N, H.A.	4000-4500	500-650
Buna N, L.A.	3000-3500	450-600
Thiokol FA	1300-1700	600-700

At 200°F. the tensile strengths for all the rubbers are lower than at room temperatures (Table 3). All of the synthetics are poorer than rubber with respect to tensile at elevated temperature. The data, however, do not justify comparative ratings of the six synthetics, and

***Numbers of tables as given here do not correspond with those in the original paper.

therefore the qualitative rating given puts them all in one class.

Table 3
(Tensile Strength at 200 deg. F., Channel Black Stocks)

	Per Cent of Tensile at Room Temp.	Per Cent Rating	Qualitative Rating
Natural Rubber	65	100	A
GR-S	33	50	B
GR-M	40	62	B
GR-I	40	62	B
Buna N, H.A.	25	38	B
Buna N, L.A.	33	50	B
Thiokol FA	33	50	B

Elongation

Five of the synthetic rubbers have less elongation at 200 deg. F. than at room temperature (Table 4). Only GR-I is similar to natural rubber in showing an increase in the amount of elongation at the elevated temperature. It seems justified, therefore, to rate GR-I qualitatively the same as natural rubber, but it is apparently not possible to distinguish between the other synthetics, which all bear the qualitative rating B.

Table 4
(Ultimate Elongation at 200 deg. F., Channel Black Stocks)

	Per Cent of Elong. at Room Temp.	Per Cent Rating	Qualitative Rating
Natural Rubber	110	100	A
GR-S	55	50	B
GR-M	70	64	B
GR-I	120	109	A
Buna N, H.A.	65	59	B
Buna N, L.A.	65	59	B
Thiokol FA	65	59	B

Tear Resistance

Methods for measuring tear resistance are not standardized, and tend to give erratic results. Therefore it may be somewhat misleading to give any absolute or relative figures for tear resistance. Table 5 is intended to bring out that apparently natural rubber is in a class by itself, that GR-M and GR-I are in a second class by themselves and that the other four synthetics in a third class.

Table 5
(Tear Resistance, Channel Black Stocks)

	Pounds per In.	Per Cent Rating	Qualitative Rating
Natural Rubber	650	100	A
GR-S	250	38	C
GR-M	450	69	B
GR-I	400	62	B
Buna N, H.A.	300	46	C
Buna N, L.A.	300	46	C
Thiokol FA	250	38	C

Abrasive Resistance

There are to the authors' knowledge no laboratory abrasive testing machines recognized by the industry as giving results comparable with those obtained in actual commercial service. One possible reason is that abrasive resistance is not a single property but a complex combination of properties. Furthermore, actual service conditions for different kinds of rubber articles are so diverse and variable that it is not surprising that laboratory tests are likely to be misleading. In consideration of these conditions no attempt has been made to present any statement regarding the relative merits of the various rubbers with respect to abrasive resistance.

Shore Hardness

Table 6 indicates the range of hardness usually obtainable with natural rubber and synthetic rubbers. However, when the extreme values of the hardness ranges given are used, other properties may be seriously impaired or processing difficulties encountered which may limit these hardness values to special applications. When the upper limit of hardness is given as 100, that means that that rubber or synthetic will form hard rubber or ebonite as that term is commonly understood. Buna N, L.A. is not shown in Table 6, but will also form hard rubber and has about the same lower limit of hardness as Buna N, H.A. GR-M, GR-I and Thiokol FA do not form hard rubber in the commonly accepted meaning of the term.

Table 6
(Shore Hardness, Representative Range)

	Commercial Shore Hardness 5-Sec. Reading
Natural Rubber	20-100
GR-S	35-100
GR-M	20- 90
GR-I	15- 75
Buna N, H.A.	20-100
Thiokol FA	25- 80

Resilience

Absolute values for resilience and rebound vary considerably according to methods used to determine them, and have been omitted from Table 7. Further, since resilience is a composite property of hardness and internal friction, from a strictly scientific viewpoint it should not be discussed quantitatively, only qualitatively.

The qualitative ratings A, B, and C have arbitrarily been given to indicate the resilience properties of the various synthetic rubbers, depending upon their percentage ratings.

All absolute values for resilience are higher when determined at 200° F. than at room temperature. The rate of increase in resilience with temperature varies with the different rubbers, however, and the percentage relationships may change with temperature. Thus, for example, the resilience of GR-I or of Buna N, H.A. increases with temperature much faster than that of natural rubber; whereas apparently the resilience of GR-S channel black stock increases with temperature more slowly than that of a similar natural rubber stock.

Broadly speaking, the relative positions of the synthetics are the same with respect to resilience for gum stocks, zinc oxide stocks, and channel black stocks. But there are two interesting statements that have been made in this regard which perhaps should be brought out here. Dr. L. B. Sebrell (Goodyear Tire and Rubber Co.) states that ". . . for most purposes it can be assumed that the relative values of the gum stocks persist after the addition of gas black. Furthermore, it can be inferred that carbon black reinforcement affects the resilience of both natural and synthetic rubber in the same way and by essentially the same mechanism. The general rule appears to be that 40 parts of gas black in 100 parts of polymer cause a 40% decrease in the resilience from the value of the gum stock." On the other hand, R. K. Estelow (Columbian Carbon Co.) has found that as carbon loading is increased the rebound decreases at different rates for natural rubber, Neoprene GN, and Buna-S, so that it is quite possible for a Neoprene channel black stock to have a higher resilience than a similar natural rubber carbon black stock, although the gum stocks are in the reverse order with respect to resilience.

Table 7
(Resilience, Channel Black Stocks)

	Percentage Rating		Qualitative Rating	
	Room Temp.	200°F.	Room Temp.	200°F.
Natural Rubber	100	100	A	A
GR-S	85	80	B	B
GR-M	95	110	A	A
GR-I	30	65	C	C
Buna N, H.A.	40	85	C	B
Buna N, L.A.	80	90	B	A
Thiokol FA	95	85	A	B

The relatively low resilience of GR-I as shown in Table 7 is probably connected with state of cure, and can possibly be improved by special compounding. It should also be stated that by using proper plasticizers the resilience of all the rubbers can be improved, with the result that the percentage ratings would be changed and the spread between them reduced. Thiokol FA, it should be noted, has relatively high recovery under momentary distortion as measured by rebound; it is only under sustained compression that this synthetic tends toward high set.

Heat Build-up

Heat build-up, like resilience, is a composite property depending upon hardness and internal friction, and therefore the qualitative ratings as given in Table 8 are less controversial than percentage ratings. As in the case of resilience, GR-M again falls in class A along with rubber, and GR-I has the lowest rating according to available data.

Table 8
(Heat Build-up, Channel Black Stocks)

	Percentage Rating Based on Temp. Rise	Qualitative Rating
Natural Rubber	100	A
GR-S	75	B
GR-M	90	A
GR-I	60	C
Buna N, H.A.	75	B
Buna N, L.A.	75	B
Thiokol FA	70	C

Compression Set

In spite of the commercial importance of this test as described in A.S.T.M. standards, and in spite of the relatively large amount of available data the authors found it impossible to correlate such data or to draw any conclusions regarding the relative performance of

A LESSON IN WATER COOLING

(Write for this complete series of "Lessons")

INDUCED DRAFT COOLING TOWERS OF HORIZONTAL DESIGN

Any product which consistently leads its field is generally the one which offers the most practical combination of all desirable features at least cost. In the case of mechanical apparatus, careful *designing* is necessary to coordinate the theoretical with the physical factors; and *users' experience* will invariably point out the design which does this best. Note the greater use of *horizontal* steam condensers. Also note the success of heaters, coolers, boilers and other heat-transfer apparatus that employ the cross-flow principle.

The horizontal type cooling tower employing horizontal air-flow is another example. It has won and held first place in its field through the past five years due to the simplicity and soundness of its basic design plus the general excellence of its physical characteristics.

Increasing the efficiency of evaporative water cooling equipment is a matter of accelerating the effective rate of heat transfer. Observe how the design of a horizontal type cooling tower accomplishes this by means of *perfected air-water flow.*

AIR FLOW

AIR VELOCITY: The uniform construction, both horizontally and vertically, of the air inlet louvers, the internal filling and the drift eliminators permits an even, straight-line air flow of uniform velocity for the *full travel* through the cooling chamber.

The fan suction chamber and drift eliminator design make possible the complete, equalized control of air velocity over the entire breadth and height of the cooling chamber.

AIR QUANTITIES: Greater air quantities with least draft loss are possible in horizontal cooling towers since the design permits (a) large and ample air passage through inlet louvers (b) large and ample air passage through the filling (c) large and ample air passage through drift eliminators (d) elimination of obstructions to air flow, such as internal systems for water distribution and baffles and filling laths set broadside to the air flow, and (e) elimination of air turbulence in general.

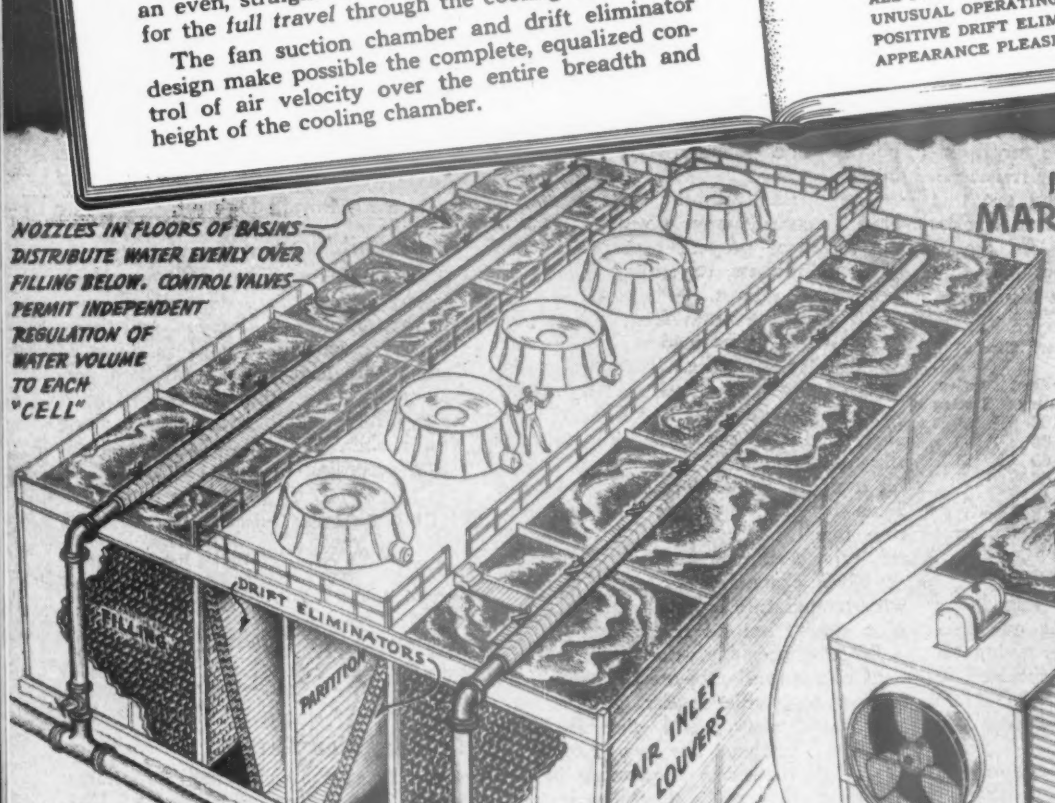
WATER FLOW

WATER DISTRIBUTION: Complete and uniform distribution of water over the entire cooling chamber is accomplished by evenly spaced nozzles located in the floor of the overhead water distribution basin. This uniformity of water coverage remains constant from top to bottom of the filling.

WATER SURFACE EXPOSURE: Initial break-up of water into fine droplets is accomplished by a diffusion deck directly beneath the discharge nozzles. On down through the cooling chamber the filling of staggered laths, on close centers both vertically and horizontally, provides a maximum of break-up and splash surface, a maximum effective wetted surface and minimum air restriction.

Not only does the horizontal cooling tower design achieve a maximum effective heat transfer rate by optimum air-water flow but it also incorporates many other noteable advantages such as

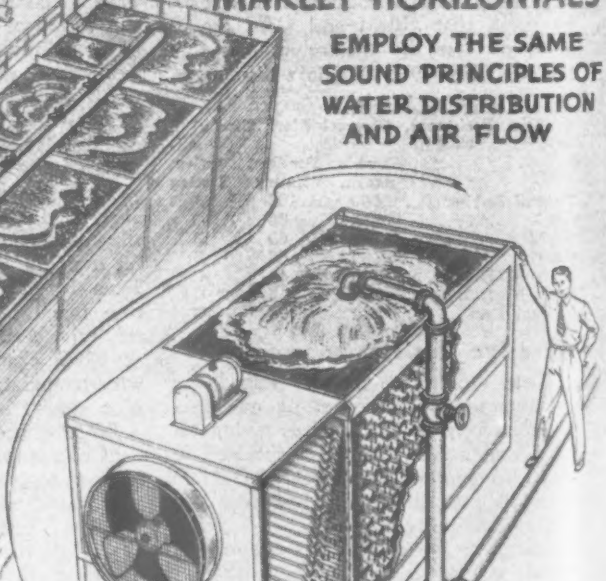
WATER DISTRIBUTION SYSTEM ENTIRELY EXTERNAL
PUMPING HEADS EXTREMELY LOW
BALANCED STRUCTURAL DESIGN, SIMPLE AND RUGGED
ALL PARTS READILY ACCESSIBLE
UNUSUAL OPERATING FLEXIBILITY
POSITIVE DRIFT ELIMINATION
APPEARANCE PLEASINGLY NEAT AND MODERN


NOZZLES IN FLOORS OF BASINS DISTRIBUTE WATER EVENLY OVER FILLING BELOW. CONTROL VALVES PERMIT INDEPENDENT REGULATION OF WATER VOLUME TO EACH "CELL"
DRIFT ELIMINATORS
PARTITION
AIR INLET LOUVERS
ENTIRE DISTRIBUTION SYSTEM OPEN TO VIEW AND EASY TO REACH, EVEN WHILE IN OPERATION

A TYPICAL "DOUBLE-FLOW" HORIZONTAL

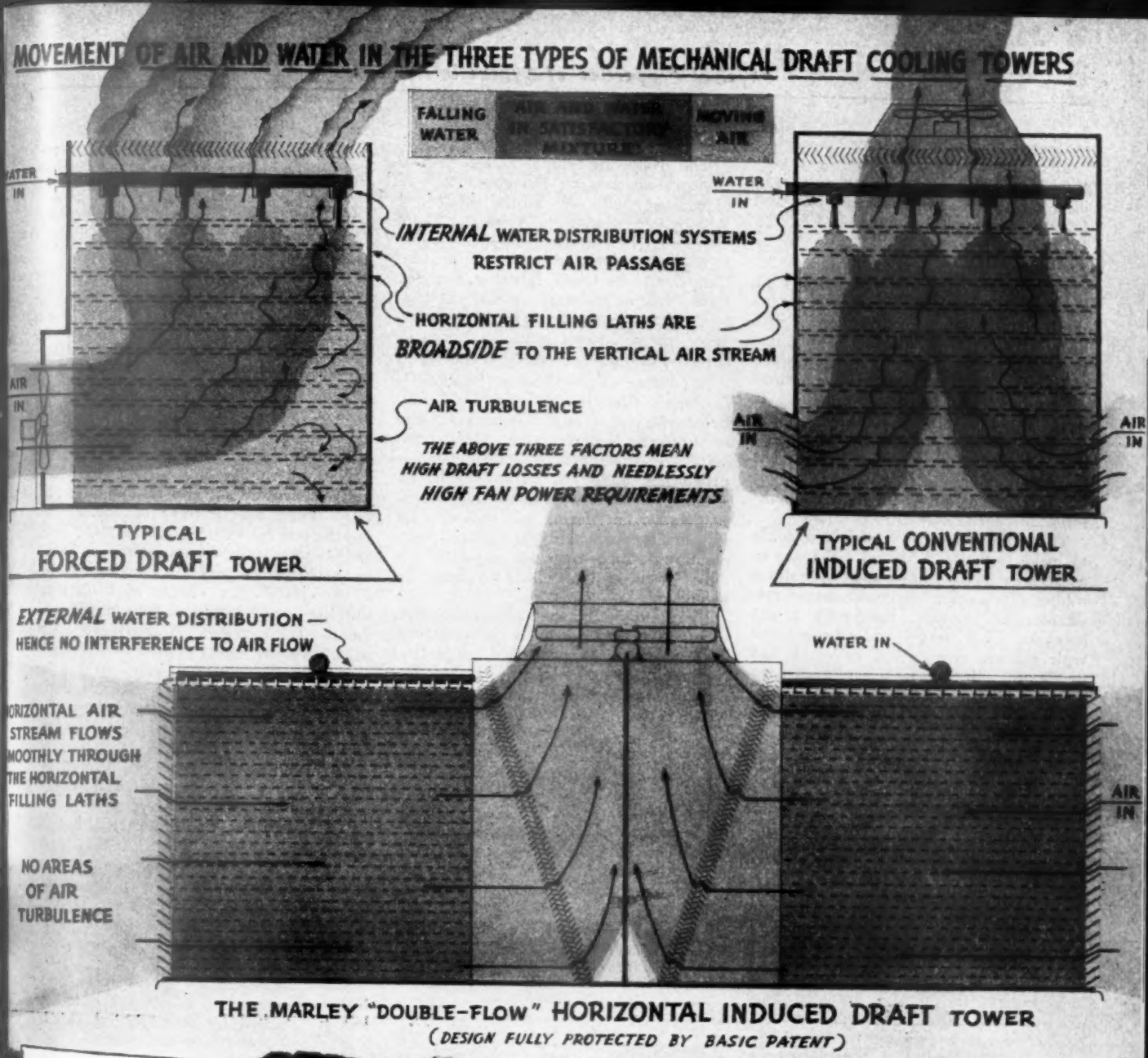
IN ALL SIZES MARLEY HORIZONTALS

EMPLOY THE SAME SOUND PRINCIPLES OF WATER DISTRIBUTION AND AIR FLOW



A TYPICAL "SINGLE-FLOW" HORIZONTAL

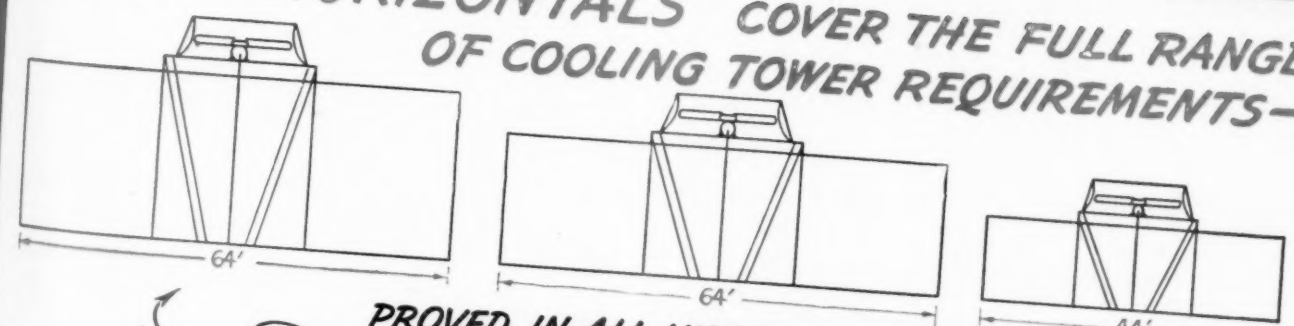
MOVEMENT OF AIR AND WATER IN THE THREE TYPES OF MECHANICAL DRAFT COOLING TOWERS


FALLING WATER
AIR AND WATER IN SATISFACTORY MIXTURES
MOVING AIR
WATER IN
AIR IN
INTERNAL WATER DISTRIBUTION SYSTEMS RESTRICT AIR PASSAGE
HORIZONTAL FILLING LATHS ARE BROADSIDE TO THE VERTICAL AIR STREAM
AIR TURBULENCE
THE ABOVE THREE FACTORS MEAN HIGH DRAFT LOSSES AND NEEDLESSLY HIGH FAN POWER REQUIREMENTS
TYPICAL FORCED DRAFT TOWER
TYPICAL CONVENTIONAL INDUCED DRAFT TOWER
EXTERNAL WATER DISTRIBUTION — HENCE NO INTERFERENCE TO AIR FLOW
WATER IN
HORIZONTAL AIR STREAM FLOWS SMOOTHLY THROUGH THE HORIZONTAL FILLING LATHS
NO AREAS OF AIR TURBULENCE
AIR IN

THE MARLEY "DOUBLE-FLOW" HORIZONTAL INDUCED DRAFT TOWER

(DESIGN FULLY PROTECTED BY BASIC PATENT)

MARLEY HORIZONTALS COVER THE FULL RANGE OF COOLING TOWER REQUIREMENTS—



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LARGEST TO SMALLEST

MARLEY COOLING TOWERS

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KANSAS CITY, KANSAS

synthetics and natural rubber.

One statement can be safely made: that Thiokol FA has relatively the highest compression set, as is to be expected from its thermoplastic nature.

Flexing Life

On account of the large number of flexing tests in use and the lack of quantitative agreement among them it has been impossible to attempt a quantitative rating for flexing life or fatigue resistance. Only the comparative ratings shown in Table 9 are presented. If heat is not involved, or if no cracks are present at the beginning of a test, then the results may be quite different from those obtained where a cut is initially present, or where high temperatures are encountered.

The only statement it seems possible to make is that GR-M and GR-I are in a superior class comparable to natural rubber. One other statement seems justifiable also, namely, that with a cut specimen GR-S is very bad as compared with rubber; once a cut or crack has developed, GR-S has little resistance to its continued growth.

Table 9

(Flexing Life, Channel Black Stocks)

	Qualitative Rating
Natural Rubber	A
GR-S	B
GR-M	A
GR-I	A
Buna N, H.A.	B
Buna N, L.A.	B
Thiokol FA	B

Resistance to Aging

Using a representative aging period in the oxygen bomb, such as 7 days at 70°C., 300 lbs./sq. in. of oxygen, one may express the tensile strengths and elongations of natural and synthetic rubbers after aging as percentages of the original values, and then calculate percentage ratings for aging resistance on the basis of rubber as 100. If this is done, the tensile strength percentage rating for most of the synthetics is about 200, and the elongation percentage rating is from 110 to 150. Similarly for hot air aging (such as 24 hours at 250°F. in the oven), the percentage ratings for tensile strength for the synthetics lie in the range of 200-500, as compared with natural rubber, and for elongation the ratings lie in the range 110-400.

In general, then, it can be said that all of the synthetics are better than natural rubber with respect to tensile strength both after aging in the oxygen bomb and in the oven at elevated temperatures.

As for aging in steam, comparative data are not available, but it is known that the aging of some of the synthetics in steam is quite different from their aging in hot air.

Thiokol FA is thermoplastic, but can apparently be used under temperature conditions up to 180°F. for long periods of time.

Volume Change

The following three tables present comparative data on the effect on volume of synthetic and natural rubbers of 3 different petroleum products: light oil (Table 10), aviation gasoline (Table 11), and 65-octane gasoline (Table 12). Care should be taken, however, that the term "volume change" is not used as synonymous with the term "oil resistance", inasmuch as volume change is only one of many factors in oil resistance.

A positive volume change or swell is frequently desirable in commercial rubber goods, but a negative volume change or shrinkage is undesirable. Many commercial compounds contain softeners or plasticizers added to improve cold resistance, and these materials may leach or dissolve out during immersion in oil or solvents, particularly at elevated temperatures. Such behavior naturally reduces swell, and may actually result in shrinkage.

More significant than volume change or swell is resistance to disintegration and maintenance of original properties. Neoprene, for example, will reach equilibrium with respect to volume increase within a few days at 212°F. in Sun Circo light process oil, whereas natural rubber keeps on swelling and eventually disintegrates. GR-S also keeps on swelling, but resists disintegration for a considerably longer period than does natural rubber. Buna N also reaches equilibrium within a comparatively short time after immersion, and tends to maintain its original properties.

Table 10

(Volume Change in Sun Circo Light Process Oil*, 70 Hours at 158°F., Channel Black Stocks)

	Per Cent Volume Increase	Per Cent Rating	Qualitative Rating
Natural Rubber	165	100	C
GR-S	125	132	C
GR-M	65	254	B
GR-I	240	69	C
Buna N, H.A.	3	5500	A
Buna N, L.A.	15	1100	B
Thiokol FA	2	8300	A

*Sun Circo Light Process Oil appears to be a satisfactory material for use in comparing the various rubbers for the reason that it has a known and fairly low aniline point—157°F. ±3°.

Table 11

(Volume Change, Reference Fluid SR-6*, 70 Hours at Room Temp., Channel Black Stocks)

	Per Cent Volume Increase	Per Cent Rating	Qualitative Rating
Natural Rubber	180	100	C
GR-S	210	86	C
GR-M	125	145	C
GR-I	110	160	C
Buna N, H.A.	20	900	A
Buna N, L.A.	50	360	B
Thiokol FA.	10	1800	A

*Reference Fluid SR-6 was developed by Stanco Distributors. It is a blend of 40% by volume of aromatic hydrocarbons (benzene 5%, toluene 20%, xylene 15%) and 60% of essentially pure diisobutylene, plus an approved aviation gasoline inhibitor. It is intended for use as a test fluid in place of highly aromatic aviation gasoline.

Table 12

(Volume Change, Reference Fluid SR-10*, 70 Hours at Room Temp., Channel Black Stocks)

	Per Cent Volume Increase	Per Cent Rating	Qualitative Rating
Natural Rubber	140	100	C
GR-S	115	122	C
GR-M	30	470	B
GR-I	150	94	C
Buna N, H.A.	1	14000	A
Buna N, L.A.	10	1400	B
Thiokol FA.	1	14000	A

*Reference Fluid SR-10, also developed by Stanco Distributors, consists essentially of the non aromatic constituents of Reference Fluid SR-6. It is intended for use as a test fluid in place of 65 octane gasoline.

Chemical Resistance

Natural rubber is resistant to HCl, any concentration, and H_2SO_4, up to 50%, under temperatures of 150°F. It is attacked by HNO_3, conc. H_2SO_4, and CrO_3. It is resistant to dilute or concentrated NaOH and KOH up to 150°F. Above 150°F. the effects of oxidation, diffusion, and absorption become aggravated. Hard rubber is much superior to soft rubber in its resistance to many chemicals. For example, hard rubber is resistant to $HC_2H_3O_2$, any concentration, up to 150°F. It is also resistant to dilute and concentrated NH_4OH, up to 100°F.

GR-S and both types of Buna N possess about the same chemical resistance as does natural rubber.

GR-M is resistant to dilute HCl, but is attacked by concentrated H_2SO_4 and concentrated HNO_3. By employing special compounding it can be made resistant to dilute H_2SO_4, dilute HNO_3, and concentrated HCl. It swells moderately in 50% NaOH, but is resistant to NH_4OH and NH_3.

GR-I is resistant to dilute acids, and both dilute and concentrated alkalies, but is attacked by concentrated H_2SO_4 and concentrated HNO_3.

Thiokol FA likewise is resistant to dilute acids, and both dilute and concentrated alkalies, but is attacked by concentrated acids.

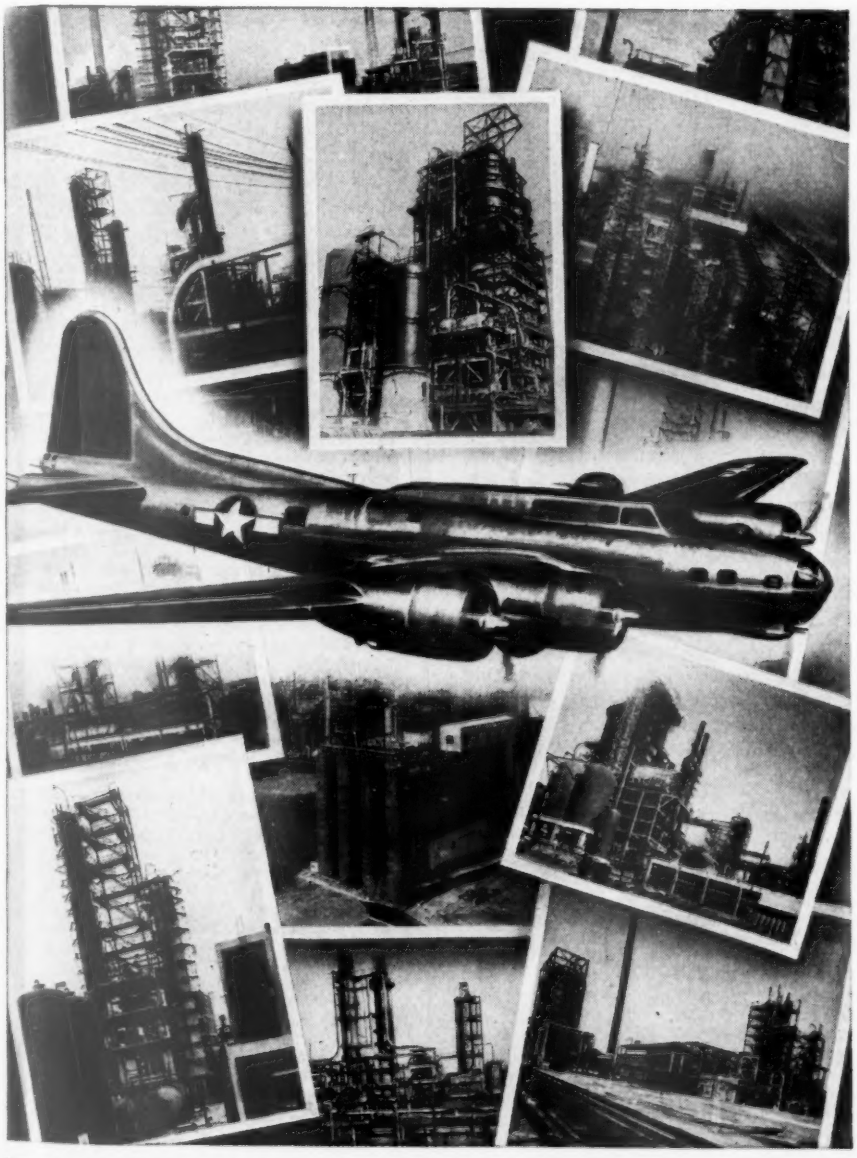
Sunlight Resistance

With respect to the qualitative ratings given in Table 13 on sunlight resistance, some results indicate that GR-S should perhaps be rated lower, and other results indicate that Buna N should be rated in a class with natural rubber. There is less controversy regarding the members of class A. GR-M and Thiokol have a long and excellent record with respect to sunlight resistance. GR-I is a relative newcomer, and light colored stocks tend to become somewhat tacky when exposed to sunlight; there is no evidence, however, that black GR-I stocks do not resist sunlight excellently.

One characteristic of Neoprene (GR-M) should be mentioned. If it is to be used in contact with fabrics it should be specially compounded to counteract possible formation of hydrochloric acid during aging. This precaution is perhaps especially necessary

Team-work job gives allied air-fighters big edge

A tribute to the thousands of patriotic workers who have built and are manning our aviation gasoline plants.



● TWO YEARS AGO the armed forces called on the petroleum industry to increase production of 100-octane aviation gasoline to fuel the world's mightiest air force then in the making. It was no easy task. It meant building more than a hundred great new units, converting many old ones.

Thanks to the scientists, engineers, builders, and workers, the job is nearly done. Production will soon be more than ten times what it was when we went to war. A great stream of the dynamic stuff which gives our airmen the edge over their enemies is already flowing to the battle fronts. Adolf and Tojo will never be able to match it.

To Standard of Indiana and its subsidiaries was assigned a major role in this great program. We take off our hats to the thousands of construction workers who turned blueprints into operating units, to the process workers who today are bringing production up to the point that our plants alone will soon be making *enough 100-octane gasoline to power a 1000-bomber raid on Berlin every other day.*

The men responsible for this achievement can have the satisfaction of knowing it is one of the important steps in America's war production program—destined to be one of the deciding factors in the final victory.

Oil is Ammunition . . . Use it Wisely. Buy more War Bonds.

STANDARD SERVICE

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where thin films (less than 0.015 in.) of Neoprene on fabric are subjected to the action of sunlight.

In connection with sunlight resistance, the testing of rubber compounds in sunlight is an uncertain kind of testing. Not infrequently a series of compounds exposed at different localities will be rated quite differently. For this reason, and also because very few comparative data are available, it would be misleading to attempt to rate the synthetics quantitatively.

Table 13

(Sunlight Resistance, Channel Black Stocks)

	Qualitative Rating
Natural Rubber	B
GR-S	B
GR-M	A
GR-I	A
Buna N, H.A.	C
Buna N, L.A.	C
Thiokol FA	A

Ozone Resistance

The action of ozone on various rubbers is similar to the action of sunlight with two important differences. It is much faster and more severe, and it occurs only when the sample is stretched to within a certain critical elongation range.

The qualitative ratings shown in Table 14 place GR-M, GR-I and Thiokol in class A, superior to natural rubber, the same as they are with respect to sunlight resistance. But the speed with which ozone acts obliterates essential differences between the effects on the other rubbers. There is a much wider gulf between the A and B ratings for ozone resistance than between the A and B ratings for sunlight resistance. For example, a natural rubber stock might be quite good in sunlight and yet worthless in ozonized air.

Table 14

Ozone Resistance, Channel Black Stocks

	Qualitative Rating
Natural Rubber	B
GR-S	B
GR-M	A
GR-I	A
Buna N, H.A.	B
Buna N, L.A.	B
Thiokol FA	A

Permeability to Gases

All of the synthetics tested show a lesser amount of permeability to hydrogen, helium and carbon dioxide than natural rubber. Although the absolute values for Helium (Table 16) are in general lower than those for Hydrogen (Table 15), the permeability relationships of the various rubbers for both gases are not greatly different. With Carbon Dioxide (Table 17), however, natural rubber is relatively poor and butyl rubber is excellent.

The values given in Tables 15, 16 and 17 were obtained by T. P. Sager, National Bureau of Standards, by the interferometer method. The determinations were made with atmospheric pressure on the air side of the specimen and a pressure of 30 mm. of water on the gas side. The values are reported as milliliters of gas per centimeter thickness per square centimeter of area per minute time.

Table 15

Permeability to Hydrogen, Gum Stocks

	Ml./Cm.Thick./Cm.²/Min. at 25°C.	Percent Rating
Smoked Sheet	22.5	100
Buna S (1942)	19.8	114
Buna S (1943)	16.2	139
Neoprene GN	5.5	410
GR-M	6.7	336
Butyl Rubber	3.3	685
Hycar OR-15 (1940)	3.5	645
Hycar OR-25	4.1	550
Perbunan (1942)	8.3	270
Thiokol FA	1.7	1325

Table 16

Permeability to Helium, Gum Stocks

	Ml./Cm.Thick./Cm.²/Min. at 25°C.	Percent Rating
Smoked Sheet	14.6	100
Buna S (1942)	12.1	120
Neoprene GN	4.1	355
Butyl Rubber	4.1	355
Hycar OR-15 (1940)	3.3	440
Perbunan (1942)	5.6	260
Thiokol FA	1.1	1330

Table 17

Permeability to Carbon Dioxide, Gum Stocks

	Ml./Cm.Thick./Cm.²/Min. at 25°C.	Percent Rating
Smoked Sheet	65.0	100
Neoprene GN	11.0	590
Butyl Rubber	1.1	5900
Hycar OR-15 (1940)	4.9	1325

Dielectric Constant

Natural rubber, GR-S and GR-I, as is clearly shown by the values presented in Table 18, have good electrical properties. The data do not indicate that any separation of the remaining synthetics should be attempted, as none of these materials is suitable for use where a low dielectric constant is required.

Corresponding comparative data on power factor, resistivity and dielectric strength are meager and unsatisfactory, but indicate that the qualitative rating for the various rubbers will be the same for those three properties as for dielectric constant.

Table 18

Dielectric Constant, Gum Stocks

	Specific Inductive Capacity, 1000 Cycles Room Temp.	Percent Rating	Qualitative Rating
Natural Rubber	2.69	100	A
GR-S	2.68	100	A
GR-M	6.70	40	B
GR-I	2.32	116	A
Buna N, H.A.	5.58	48	B
Buna N, L.A.	10.90	25	B
Thiokol FA	7.10	38	B

Standard Specifications

In connection with this subject of physical properties, a tabulated system for denoting standard physical properties for natural and synthetic rubber compounds has been developed by Technical Committee A of A.S.T.M. Committee D-11, jointly sponsored by the A.S.T.M. and S.A.E.* The tables, as set up, cover applications in the automotive and aeronautical fields, and do not include tires, inner tubes, sponge or hard rubber, or the general mechanical and industrial fields.

The system divides the rubbers into two classes—non-oil resistant (class R) and oil resistant (class S). It covers such properties as durometer hardness, tensile strength, elongation, oven aging, compression set, load deflection, oil resistance, weather resistance and flexibility at —40°F. and —70°F.

Information on the system has been published under the A.S.T.M. designation D-735-43T, and will shortly appear in the new edition of the S.A.E. handbook.

List of Symposium Papers

Following is a complete list of papers presented at the symposium on "Applications of Synthetic Rubbers" at the spring meeting of the American Society for Testing Materials, Cincinnati, March 2, 1944:

1. The Origin and Development of Synthetic Rubbers—Harry L. Fisher, U. S. Industrial Chemicals, Inc.
2. Physical Tests of Synthetic Rubber Products—Leslie V. Cooper, The Firestone Tire & Rubber Co.
3. Physical Properties of Synthetic Rubbers—John M. Ball and G. C. Maassen, R. T. Vanderbilt Co.
4. Specifications for Synthetic Rubber Compounds—M. J. DeFrance, Goodyear Tire and Rubber Co.
5. Processing Characteristics of Synthetic Rubbers and Their Use in Extruded Products—A. E. Juve, The B. F. Goodrich Co.
6. Synthetic Rubber Tires and Inner Tubes—P. M. Torrance, The Firestone Tire and Rubber Co.
7. Hose and Belting Made from Synthetic Rubber—W. L. White, Manhattan Rubber Mfg. Div., Raybestos-Manhattan, Inc.
8. The Use of Synthetic Rubbers in Molded Products — Merle Sanger, The General Tire and Rubber Co.
9. Cellular Rubbers—Louis P. Gould, Inland Mfg. Div., General Motors Corp.
10. Hard Rubber Products from Synthetics—Walter H. Juve, Consulting Rubber Technologist.
11. Use of Synthetic Rubbers for Insulated Wire and Cable—R. A. Schatzel, General Cable Corp.
12. The Use of Synthetic Rubber in Footwear—Stanton Glover, United States Rubber Co.
13. Synthetic Rubber Adhesives — Fred J. Wehmer, Minnesota Mining and Mfg. Co.

All papers are to be published in full by the Society. Address inquiries to the A.S.T.M., Secretary-Treasurer, 260 S. Broad St., Philadelphia 2.

*A paper, "Specifications for Synthetic Rubber Compounds" by M. J. DeFrance of The Goodyear Tire and Rubber Co., Akron, Ohio, presented at the symposium of the A.S.T.M., Cincinnati, March 2, 1944, explains the system in detail.

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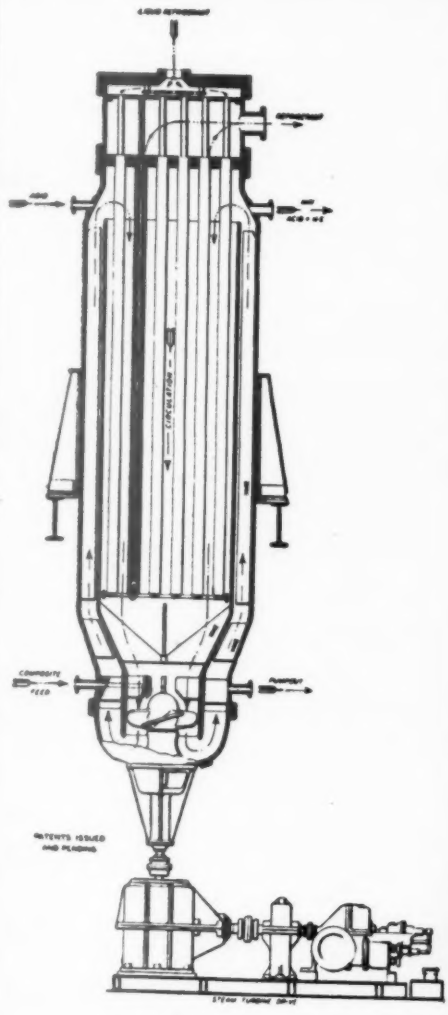

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Key Technologists in New Wartime Plants

Standard of California's El Segundo Refinery

FACILITIES for producing 100-octane aviation gasoline components at the El Segundo refinery of Standard Oil Co. of California have been expanded to the point where present output of the finished product is nearly five times the substantial average daily output of 1941.

Operations at this refinery for the production of 100-octane gasoline do not constitute a "new" plant in the accepted sense of that term. While many new units have been built to produce this product, the older units are contributing various components.

The cracking division embraces most of the plants producing the principal constituents of 100-octane. It operates the thermal cracking and reforming units; a large alkylation plant; two isomerization plants, the larger of which was completed only a few months ago; the first catalytic cracking unit installed on the Pacific Coast, and many other smaller units.

The men directing various operations concerned with 100-octane production are: Richard K. Rowell, refinery manager; W. W. Davison, assistant manager for industrial relations; Fred Powell, assistant manager for operations; Charles E. Allen, superintendent, light oil division; Earle L. Scofield, superintendent, lub oil division; Dr. Ernest E. Lyder, superintendent, cracking division. Mr. Davison and Mr. Powell directly oversee operations, under Mr. Rowell.

Operations directed by Mr. Allen include low pressure distillation, the first step in 100-octane production. Some of this production goes directly into 100-octane. Principally, however, this division produces the charging stock for reformers and thermal cracking units. In some cases, it produces special cuts that go into the catalytic cracking units. This operation also handles the blending that makes up the final 100-octane product.

Mr. Scofield's division operates all the utility systems and superintends the packaging and shipment of the finished product in drums and tins.

R. K. Rowell

W. W. Davison

Fred Powell

C. E. Allen

E. L. Scofield

E. E. Lyder

Dr. Lyder superintends the cracking division. The latest major addition to the refinery's war activities also comes under his direction. This is the butadiene plant near the refinery, which is operated under the supervision of the refinery organization by a staff supplied by the refinery. Sketches of the six men mentioned above follow:

Richard K. Rowell started with Standard of California 26 years ago as a still cleaner at the Richmond refinery. He rose through various jobs to become superintendent of the pressure stills there and then was transferred to the same position at El Segundo. Five and one-half years ago he became refinery superintendent there, being promoted to manager early in 1943. He served two years in a U. S. aero squadron in the last war.

W. W. Davison went to work with the company 23 years ago as a job engineer at El Segundo, after graduating in mechanical engineering from the University of California. He has worked here since, except for three and a half years spent with Standard Oil Co. of British Columbia. He became assistant manager of the El Segundo plant March 1, 1943.

Fred Powell joined Standard 19 years ago, not long after graduating in chemical engineering from the University of Washington. He worked up the ladder at the Richmond and Bakersfield plants before going to El Segundo, where he became assistant manager Oct. 1, 1943.

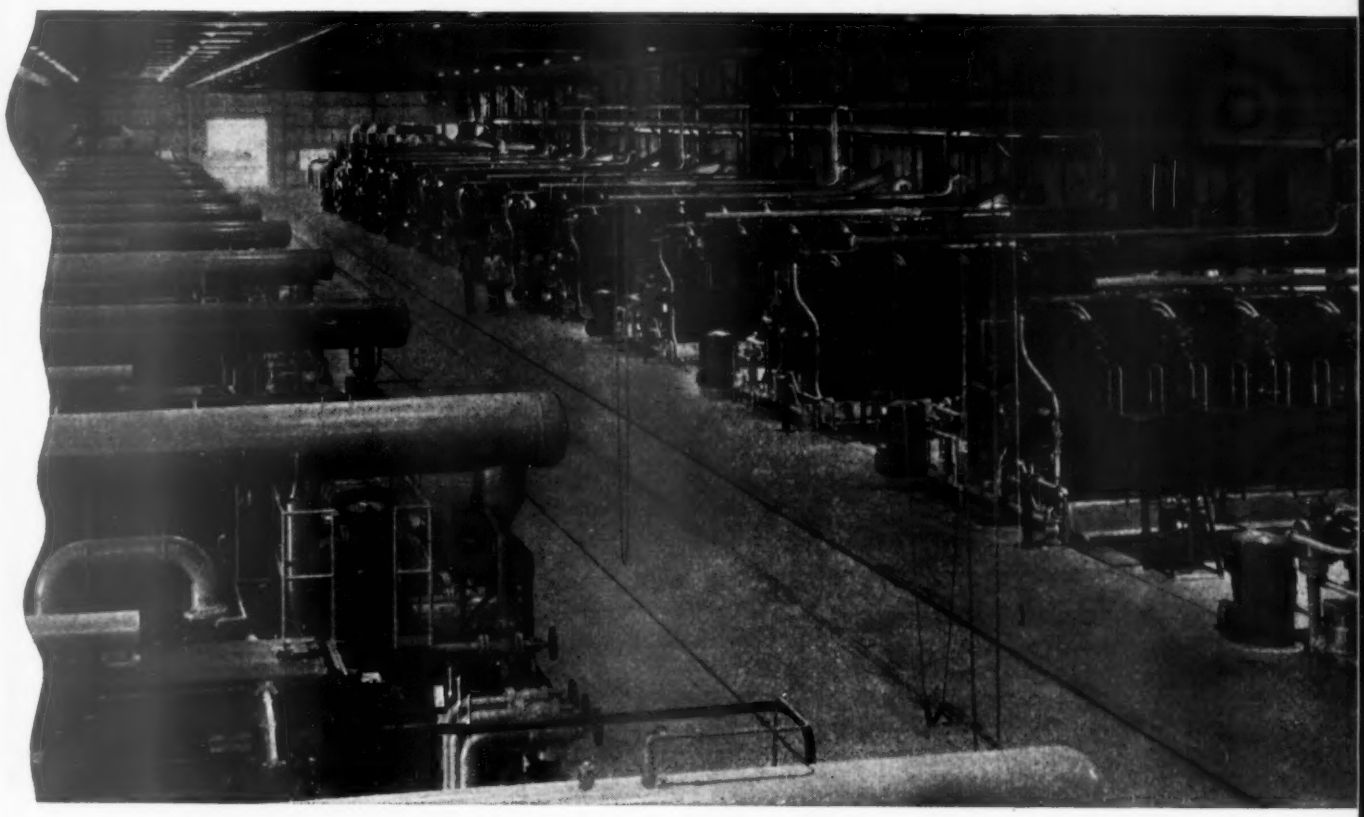
Charles E. Allen started to work as a draftsman at the Richmond refinery 13 years ago. He is a graduate in electrical engineering of the University of Washington. After two years he went to El Segundo as an economy standards man and advanced until he became superintendent of the light oil division Oct. 1, 1943.

Earle L. Scofield has seen 35 years as a Standard of California employe. He went to work from high school in the Richmond refinery inspection laboratory. Thirteen years ago he transferred to El Segundo as foreman of the lubricating oil dept. and became superintendent of the lubricating oil division June 1, 1940.

Dr. Ernest E. Lyder has been with Standard 19 years. He holds A.B. and M.S. degrees in chemical engineering from University of Kansas and a Ph. D. degree in the same field from Columbia. He was a private in the chemical warfare unit in the last war and served as chemist for various concerns before joining Standard of California. He spent two years as research specialist in the Research and Development Department at the Richmond refinery. For the past 5 years he has been superintendent of the cracking division at El Segundo.

DELIVERING 24,000 HORSEPOWER

24 G-MV's Producing Synthetic Ammonia FOR TNT



TWENTY-FOUR 1000 hp Cooper-Bessemer G-MV compressors in a new western arsenal, turning out synthetic ammonia for the manufacture of TNT! The name and location of the plant, and the date of installation cannot be revealed.

The compressors are ten-cylinder, multi-stage gas-driven V-angle compressors of the compact type widely used in the manufacture of synthetic rubber, plastics, chemicals and other war and peacetime products. Either gas or diesel fuel can be used and the switch from one fuel to the other can be accomplished by making only a few simple changes.

The selection of these compressors for this important national work is a testimonial to their reliability and efficiency. Wherever compressors are used, the name Cooper-Bessemer stands for low over-all cost and long trouble-free operation.

TYPE G-MV ANGLE

Compressors

by Cooper-Bessemer

MOUNT VERNON, OHIO AND GROVE CITY, PENNA.

Houston, Dallas, Greggton, Pampa and Odessa, Texas Tulsa Shreveport St. Louis Los Angele
New York Washington Bradford, Pa. Parkersburg, W. Va. San Francisco, Cal. Seattle, Wash

The Corrosion and Stability Test For Lubricating Oils*

Data from tests on the Corrosion and Stability apparatus for studying the corrosive tendencies of lubricating oils were correlated with the 36-Hour Chevrolet Engine test. Correlation of the results of tests with behavior of oils in various types of engines is considered to be generally satisfactory. Correlation oils selected by the S.A.E. Crankcase Oil Stability Research Committee were rated by the C and S tests and these ratings compared with those in the committee's report. The C and S test has also been employed in the preliminary examination of lubricants prior to protracted approval tests in heavy-duty type engines. It is believed the corrosion and stability characteristics of oils can be predicted with reasonable accuracy.

The Corrosion and Stability apparatus and conditions of test were described in Part 1, in the March 1st Technical Supplement.

*By George W. Waters**†, Elder C. Larson** and Ben Borus***

Part 2

IN THEIR development, the standard Corrosion and Stability tests were correlated with the 36-hour Chevrolet Engine test, since considerable data (10) are available from the recent correlation program carried out on this engine test under the supervision of the sub-committees of Sub-Division B of the Lubricants Division of the Society of Automotive Engineers.

Correlation of C and S-30 with 36-Hour Chevrolet Engine Test

In Table 9 and Fig. 9 are presented the correlation data for C and S-30 and the 36-hour Chevrolet Engine Test. Pertinent points of discussion can be summarized as follows:

(a) The precision of the C and S-30 is strikingly good for this type of test, both as concern potential corrosivity and oil deterioration. Average error for these data, expressed as average deviation from the mean, is ±8.2%.

(b) Some reversals will be observed. Oils B 1 and B-3 are reversed by the laboratory test from the relative ratings in the engine in respect to corrosivity, increase in neutralization number and increase in carbon residue, and B-1 and B-2, are reversed as concerns increase in viscosity. The reversal of B-1 and B-3 in corrosivity is not considered serious since one-third of the participating engine laboratories either rated these oils in the same order as did the C and S-30, or rated them as equal.

Further, the averages for all engine laboratories on the corrosivity of these two oils separated them by only 14% of the lower figure (16mg/cm² for B-1, 14mg/cm² for B-3), which is well within the precision of the engine test. The reversal of B-1 and B-2, in respect to increase in viscosity, occurs again with two oils on which the least differentiation was made by the engine.

The C and S-30 found most difficult the reproduction of engine performance as regards formation of sludge and insoluble bodies. It is logical that the interfering factors attributable to the fuel, fuel combustion products, dust and dirt, influential in the engine but absent in the laboratory test, will accentuate differences between the two. Notwithstanding, it is evident that C and S-30 distinguished B-4 as the worst oil in regard to naphtha insolubles, chloroform solubles and increase in carbon residue.

(c) It is worthy of mention that neither the C and S nor the engine test rates the corrosivity of the oils in the same order as in development of neutralization number. Thus, further evidence is provided of the inadequacy of neutralization number as a criterion of the development of corrosivity.

Correlation of C and S-10 with 36-Hour Chevrolet Engine Test

In Table 10 and Fig. 10 are presented the correlation data for C and S-10 and the 36-hour Chevrolet Engine Test. Pertinent points of discussion can be summarized as follows:

(a) A relatively high order of precision

*The material forming the basis for this paper was presented before the Petroleum Division of the American Chemical Society, April 12-16, 1943, Detroit, and has been published in the Industrial & Engineering Chemistry.

**Wood River Research Laboratories, Shell Oil Co., Inc., Wood River, Ill.

†Present address, Shell Oil Co., Inc., New York.

TABLE 9—Correlation of C and S-30 with the 36-Hour Chevrolet Engine Test on the Basis of the Four S.A.E. Correlation Oils of 30-Viscosity Grade

Property		S.A.E. Correlation Oil B-1	S.A.E. Correlation Oil B-2	S.A.E. Correlation Oil B-3	S.A.E. Correlation Oil B-4
Bearing Weight Loss mg/cm²	C and S-30	0.81 ± 0.1$_5$ (19%)	6.4 ± 0.2 (3.1%)	1.4$_4$ ± 0.0$_4$ (2.8%)	0.54 ± 0.07 (13%)
	Engine Test	16 ± 6	54 ± 40	14 ± 6	10 ± 9
	Rating, C and S-30	2	4	3	1
	Rating, Engine	3	4	2	1
Increase in Neut. Number mg KOH per gm	C and S-30	0.8 ± 0.1$_5$ (19%)	4.8 ± 0.4 (8.3%)	1.2$_0$ ± 0.0$_4$ (3.3%)	2.6 ± 0.1 (3.7%)
	Engine Test	2.3	5.3	1.6	4.6
	Rating, C and S-30	1	4	2	3
	Rating, Engine	2	4	1	3
Increase in Viscosity at 100° F., SU. Secs.	C and S-30	68 ± 12 (18%)	160 ± 14 (8.8%)	24 ± 2 (8.4%)	287 ± 19 (6.6%)
	Engine Test	490	373	91	1040
	Rating, C and S-30	2	3	1	4
	Rating, Engine	5	2	1	4
Naphtha Insoluble, %w	C and S-30	0.00-0.01	0.01-0.02	0.00-0.01	1.17 ± 0.01 (0.9%)
	Engine Test	1.72	0.78	0.45	2.81
	Rating, C and S-30	....	....	....	4
	Rating, Engine	3	2	1	4
Chloroform Solubles, %w	C and S-30	<0.01	<0.01	0.00-0.01	1.16 ± 0.01 (0.9%)
	Engine Test	1.38	0.48	0.12	2.57
	Rating, C and S-30	....	....	....	4
	Rating, Engine	3	2	1	4
Increase in Conradson Carbon Residue, %w	C and S-30	0.17	0.92 ± 0.8 (8.7%)	0.34 ± 0.04 (12%)	1.02 ± 0.03 (2.9%)
	Engine Test	2.16	2.25	1.29	2.56
	Rating, C and S-30	1	3	2	4
	Rating, Engine	2	3	1	4

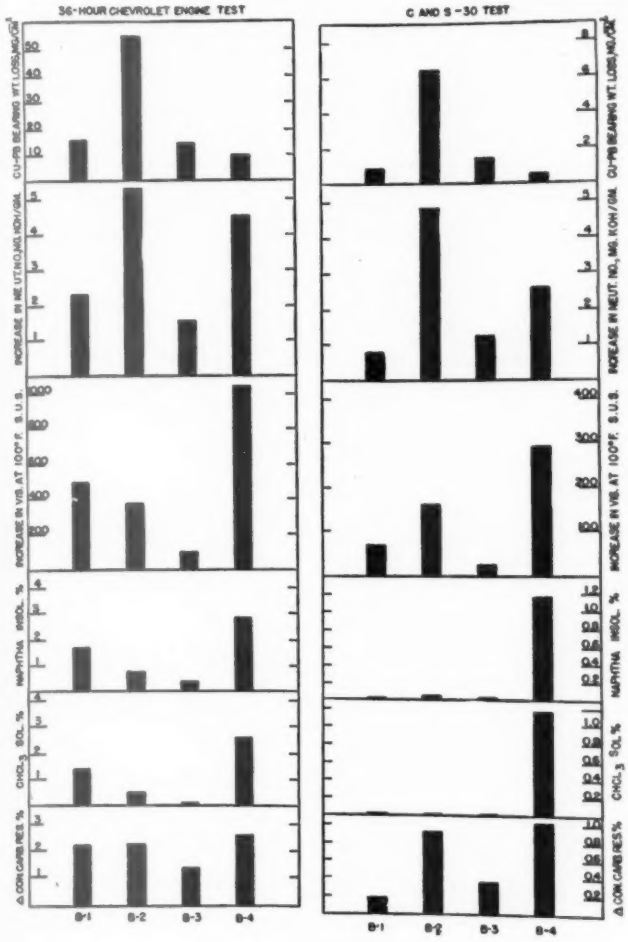


Fig. 9—Correlation data between C and S-30 and the 36-Hour Chevrolet Engine test.

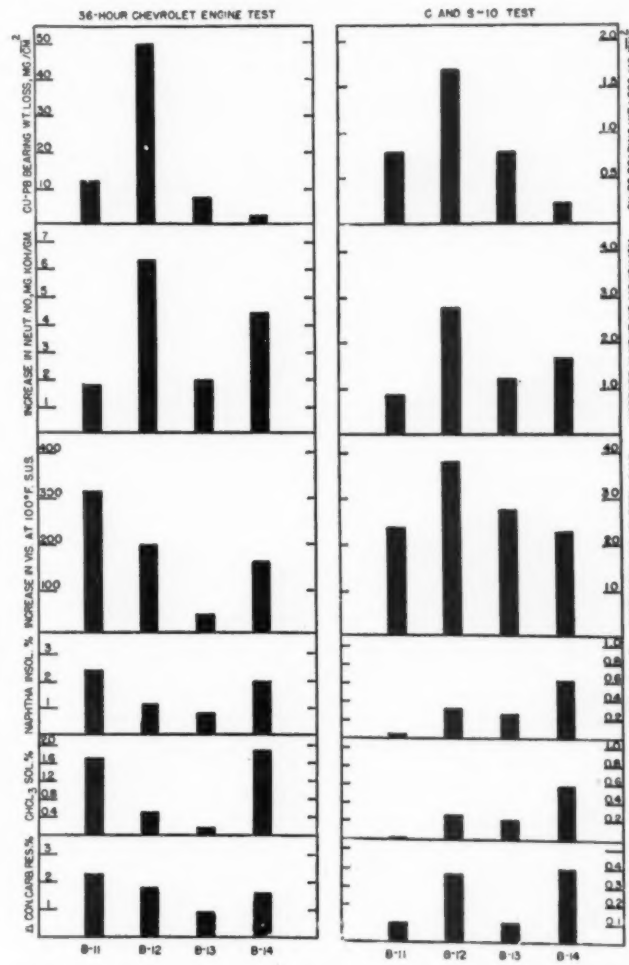


Fig. 10—Correlation data between C and S-10 and the 36-Hour Chevrolet Engine test.

TABLE 10—Correlation of C and S-10 with the 36-Hour Chevrolet Engine Test on the Basis of the Four S.A.E. Correlation Oils of 10-Viscosity Grade

Property		S.A.E. Correlation Oil B-11	S.A.E. Correlation Oil B-12	S.A.E. Correlation Oil B-13	S.A.E. Correlation Oil B-14
Bearing Weight Loss mg/cm²	C and S-10	0.79 ± 0.02 (2.5%)	1.7 ± 0.2 (12%)	0.8 ± 0.2 (25%)	0.24 ± 0.05 (21%)
	Engine Test	12 ± 3	50 ± 28	8 ± 3	2 ± 1
	Rating, C and S-10	2	4	2	1
	Rating, Engine	3	4	2	1
Increase in Neut. Number mg KOH per gm	C and S-10	0.9 ± 0.1 (11%)	2.8 ± 0.2 (7.1%)	1.2_5 ± 0.0_5 (4.0%)	1.7 ± 0.3 (18%)
	Engine Test	1.8	6.4	1.9_5	4.5
	Rating, C and S-10	1	4	2	3
	Rating, Engine	1	4	2	3
Increase in Viscosity at 100° F., S.U.S.	C and S-10	24 ± 3 (12%)	38 ± 5 (13%)	28 ± 2 (7.1%)	23 ± 6 (26%)
	Engine Test	316.3	198.1	47.1	162.3
	Rating, C and S-10	1	4	3	1
	Rating, Engine	4	3	1	2
Naphtha Insolubles, %w	C and S-10	0.04 ± (×0.005)	0.32 ± 0.02 (6.3%)	0.26 ± 0.06 (23%)	0.62 ± 0.02 (3.2%)
	Engine Test	2.42	1.16	0.80	1.95
	Rating, C and S-10	1	3 (2)*	2 (1)*	4 (3)*
	Rating, Engine	4	2 (2)*	1 (1)*	3 (3)*
Chloroform Solubles, %w	C and S-10	0.01_5 ± 0.00_5	0.27 ± 0.01 (3.7%)	0.22 ± 0.02 (9.1%)	0.58 ± 0.04 (6.9%)
	Engine Test	1.68	0.49	0.18	1.89
	Rating, C and S-10	1	3 (2)*	2 (1)*	4 (3)*
	Rating, Engine	3	2 (2)*	1 (1)*	4 (3)*
Increase in Conradson Carbon Residue, %w	C and S-10	0.12 ± 0.02 (17%)	0.37_5 ± 0.00_5 (1.3%)	0.12 ± 0.04 (33%)	0.4 ± 0.1 (25%)
	Engine Test	2.26	1.89	0.95	1.67
	Rating, C and S-10	1	3	1	4
	Rating, Engine	4	3	1	2

*Figures in parentheses represent relative ratings if Oil B-11 is eliminated from consideration.

is maintained in C and S-10; average error for these data is ±13.4%. Oils of reasonably different quality can be readily differentiated.

(b) The C and S-10 rated oils B-11 and B-13 of equal corrosivity within the precision of the test, whereas the engine test rated B-11 more corrosive than B-13. However, the precision figures for the engine tests (included in Table 10) are sufficient to permit a reversal.

(c) Correlation between laboratory and engine tests on viscosity increase is poor. However, development of naphtha insolubles, chloroform solubles and increase in carbon residue agree satisfactorily with the one exception of oil B-11.

(d) As in the case of the 30-grade oils, again there is no correlation between development of neutralization number and corrosivity.

It is to be noted from both Tables 9 and 10 that extent of corrosivity and oil deterioration in the C and S tests falls below engine test values. Standard conditions have been selected deliberately to maintain the laboratory test less severe than the engine, since the converse might be expected to imperil the validity of the test. Furthermore, it can be judged impossible to find a single set of conditions which would deteriorate all oils to the same extent as does the engine. For example, increase in severity of conditions in the laboratory test sufficient to increase the neutralization number change for Oil B-1 to its value in the engine (from 0.8 to 2.3) would be expected to cause the deterioration of Oils B-2 and B-3 to exceed that attained in the engine.

Of course, an interfering factor is the practice of adding make-up oil during the engine test, which is influential in determining the properties of the final oil sample. A more satisfactory expedient would be to measure deterioration as a function of time. This is conveniently achieved in C and S tests by sampling the oil charge at intervals during a run. The importance of time as a variable affecting oil deterioration and bearing corrosion has been previously discussed.

Definition of Permissible Limits of Corrosivity

From the data of Tables 9 and 10 a scale for rating the potential corrosivity of lubricants of these two viscosity grades has been drawn up. It is, of course, recognized that no sharp line of demarkation between non-corrosive and corrosive oils can be made. Judgment is based, rather, on "zones" of corrosivity in accordance with the schedule outlined in Table 11.

Evaluation in the Corrosion and Stability Apparatus of Lubricants Circulated by the S.A.E. Crankcase Oil Stability Research Committee (11, 12)

With conditions of test selected upon the basis of results obtained on the B-oils, various of the correlation oils selected by the S.A.E. Crankcase Oil Stability Research Committee have been studied in the C and S Apparatus, since they provided further opportunity to ascertain the accuracy with which the laboratory test predicts engine service. Oils of S.A.E.-40 grade (No 4 through 9) and of S.A.E.-60 grade (No. 16 through 18) were subjected to conditions of test selected for S.A.E.-30 grade oils (C and S 30); oils of S.A.E.-20 grade (No. 13 through 15) were tested under the conditions of both C and S-10 and C and S-30. It was elected to examine these latter oils under both the milder and more severe conditions, since no set of conditions has been established for 20-viscosity grade oils, due to the lack of engine data of the desired scope.

In Table 12 are presented the results, both from the engine and C and S-30 studies on the S.A.E.-40 grade oils. It is interesting to observe that in each case the relative ratings as established by the C and S test agree either equally well or more closely with the service ratings than do the over-all ratings of the oils in the test engines. It may be noted that oils 5, 7 and 8, described as sludging oils in service, displayed tendencies to develop excessive amounts of naphtha insolubles in the laboratory test. In regard to corrosivity, if the scale developed for S.A.E.-30 grade oils is employed, distribution of the 6 oils is as follows:

Zone I: Oils 4, 5, 7, 9 (Non-corrosive)
Zone II: Oil 8 (Borderline to mildly corrosive)
Zone III: Oil 6 (Mildly corrosive to corrosive)

It is of interest that two of the 4 oils which fall in the non-corrosive Zone I (Oils 5 and 7) nevertheless display considerable tendencies to develop acids as judged by neutralization number. Their failure to become corrosive may be at-

TABLE 11—Corrosivity-Zone Schedule for Judging the Potential Corrosivity of Lubricants from Results of C and S Tests

Zone	Description	Weight Loss, mg/cm², of Cu-Pb Bearing Insert in C and S Test for S.A.E.-10 Oils	S.A.E.-30 Oils
I	Non-corrosive	<0.5	<0.75
II	Borderline to mildly corrosive	0.5-1.0	0.75-1.5
III	Mildly corrosive to corrosive	1.0-1.5	1.5-2.0
IV	Excessively corrosive	>1.5	>2.0

TABLE 12—C and S-30 Data and Engine Data on Group I Oils (SAE-40 Grade) of the S.A.E. Crankcase Oil Stability Research Committee

		Oil Number					
		4	5	6	7	8	9
C and S-30 Data	Cu-Pb Wt Loss, mg/cm²	0.50±0.08	0.6_8±0.1_6	2.0±0.3	0.3_4±0.1_0	0.9_3±0.1_0	—(0.08±0.02)†
	Relative rank	3	3	6	2	5	1
	Δ Neut. No. mg KOH/gm	0.9±0.2	1.7_5±0.0_5	2.8±0.7	2.5±0.2	1.9±0.2	—(0.2±0.0)†
	Relative rank	2	3	5	5	3	1
	Δ Sap. No. mg KOH/gm	7±2	3.3±0.4	6.8±0.9	5.3±1.7	3.5±1.0	—(0.75±0.05)†
	Relative rank	5	2	5	4	2	1
	Vis. inc. at 100° F, %	20±3	63±4	40.5±0.5	8_0±1_0	92±6	2.1±0.0
	Relative rank	2	4	3	4	6	1
	Naphtha insoluble, %	0.01-0.02	1.42±0.04	0.03-0.04	1.6±0.2	1.79±0.07	0.04
	Relative rank	1	4	2	5	5	2
	Over-all relative rank*	2	3	5	4	6	1
See (§)	Over-all relative ratings on basis of test engine	2	3	4	6	4	1
	Relative service ratings	2	4	6	3	5	1

*This ranking empirically established as follows: corrosivity and naphtha insoluble rankings weighted each as unity; Δ Neut. No., Δ Sap. No. and Vis. Increase rankings weighted each as one-third.
†Gain. ‡Loss.
§Report of SAE Crankcase Oil Stability Research Committee (11).

Oil	Service Description
4	A very good oil but not quite as good as the best.
5	Judged not to be a good oil because of sludging and ring sticking tendencies.
6	Because of insufficient service data, it is impossible to rate this among the other oils. Shown in the laboratory to be stable at low temperature, but sticks rings quickly at high temperature.
7	Sludges too quickly to be considered among the best oils.
8	A very poor oil which had caused every sort of trouble generally considered to arise from lack of stability; a bad sludge maker and ring sticker; unquestionably this oil has the poorest service record of the lot.
9	Free from ring sticking and troubles arising from lack of stability.

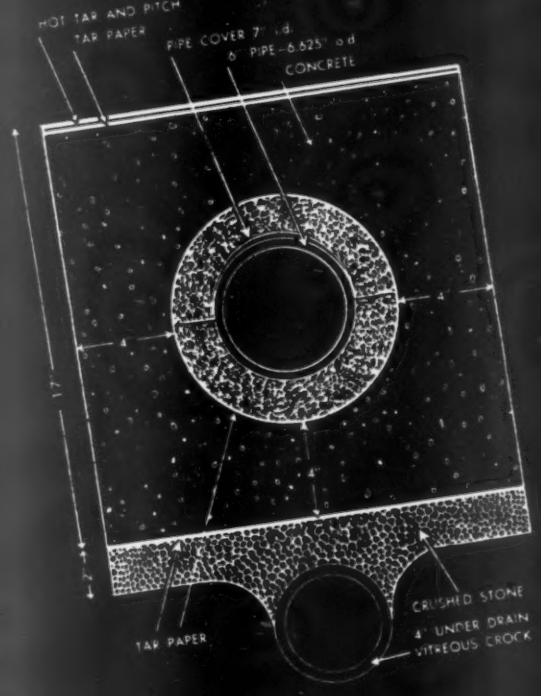
This is the 5TH in a series of messages

DEALING WITH THE PROBLEMS IN HEAT INSULATION FACED BY ENGINEERS AND SOLVED BY USING UNARCO unibestos

5a THE PROBLEM: Permanent insulation of underground steam line.

5b THE SOLUTION:

Dig underground trench to proper grade and lay sewer tile over which two inches of crushed stone is placed. Cover crushed stone with tar paper. Install pipe on wooden blocks arranged to support pipe for welding. After welding apply Unibestos sectional pipe covering to allow free movement of the pipe within the insulation, insulation should have an I. D. approximately 3/8" greater than the O. D. of the pipe. Pipes should next be brought to proper grade adjustment after waterproofing the insulation. The trench should be filled with concrete. Tar paper and tar can then be applied on top of the concrete to make the structure waterproof. The great structural strength of Unibestos permits this unique installation. Unibestos is sufficiently strong to withstand the movement and weight of the pipe.



UNION ASBESTOS & RUBBER CO.

GENERAL OFFICES: 1821 SOUTH 54TH AVENUE, CICERO, ILLINOIS • NEW YORK • SAN FRANCISCO • PATERSON, N. J.

TABLE 13—C and S Data and Engine Data on Group III Oils (S.A.E.-20 Grade) of the S.A.E. Crankcase Oil Stability Research Committee

	Oil Number					
	13		14		15	
Test Used	C & S-10	C & S-30	C & S-10	C & S-30	C & S-10	C & S-30
Cu-Pb Wt. Loss mg/cm²	0.32±0.00	0.64	0.28±0.05	0.39	2.36±0.02	4.3
Relative rank	1	2	1	1	3	3
Δ Neut. No. mg KOH/gm	2.0±0.2	3.0	0.2_5±0.0_5	0.5	5.0±0.6	11.4
Relative rank	2	2	1	1	3	3
Δ Sap. No. mg KOH/gm	3.4±0.0	5.6	—(0.6±0.2)†	3.7	19±3	28
Relative rank	2	2	1	1	3	3
Vis. inc. at 100° F.	46±2	87	2.4±0.0	4.6	53±6	280
Relative rank	2	2	1	1	3	3
Naphtha insolubles, %	1.3±0.1	1.7	0.02-0.04	0.02	0.01	0.06
Relative rank	3	3	2	1	1	2
Over-all relative rank*	2	2	1	1	3	3
Over-all relative ratings on basis of test engines	3		1		2	
Relative service ratings	3 (Close to No. 15)		1 (Much the best)		2 (Close to No. 13)	

C and S Data — See (§)

*This ranking empirically established as follows: corrosivity and naphtha insoluble rankings weighted each as unity; Δ Neut. No., Δ Sap. No. and Vis. Increase rankings weighted each as one-third.

†Loss.

§Report of SAE Crankcase Oil Stability Research Committee (12).

Oil No.	Service Description
13	An oil generally rated of low stability; in sludge forming and ring sticking, its behavior is not good.
14	An oil which has shown very good oxidation stability characteristics; under both severe and long-time mild conditions stability has been satisfactory in both gasoline and Diesel equipment and engine deposits relatively small.
15	An oil of medium stability; has worked out successfully in a wide field of application, but it fails under severe operating conditions.

tributed to deposition of protective films on the bearing surface; this is compatible with their development of high naphtha insolubles.

Table 13 lists the data on the S.A.E.-20 grade oils. The laboratory test rated the three oils in the same order under both the milder and more severe conditions. It is felt, since in the S.A.E. Committee's report (11) it is emphasized that these oils are not designed for heavy duty service, that the milder conditions of test are more appropriate. This is substantiated by the fact that under more severe conditions, Oil 15 is oxidized more severely in the laboratory test than it is in the engine. The practice, however, of testing S.A.E.-20 grade lubricants under the conditions of C and S-10 is by no means generally employed. For heavy duty, all-purpose oils, it is preferred to apply the more severe conditions of test, since there is thus provided a factor of safety. The order of rating by the C and S tests reveals that Oil 14 is definitely superior to Oils 13 and 15, which is consistent with both the test engine and service ratings. In regard to these latter two oils, it may be judged that No. 13 would be unsatisfactory from sludging trouble and No. 15 affords insufficient protection against corrosion of copper-lead bearings.

It may be remarked that the relatively great deterioration of Oil 15 exhibited by high neutralization number, saponification number and viscosity increase is due probably, in part at least, to catalysis by metal removed from the copper-lead bearing. In the absence of this factor of catalysis, the differentiation obtained in the C and S tests between Oils 13 and 15 with respect to stability would probably not be so marked. Corrosivity ratings, in accordance with the zone schedules of Table 4 for the 20-grade oils are:

Zone I: Oils 14, 13 (Non-corrosive)
Zone IV: Oil 15 (Excessively Corrosive)

It may be judged that Oil 13 fails to become corrosive through the protection afforded to the bearing surface by the deposition of products of oil oxidation (naphtha insolubles).

In Table 14 are presented the results obtained upon the oils of S.A.E.-60 viscosity grade. It will be seen that the C and S test and the test engines rate these three oils in the same order, whereas both show a reversal with respect to the service ratings of Oils 16 and 17. This reversal may be due to the selection of conditions for the laboratory test insufficiently severe for proper evaluation of lubricants of this high viscosity grade. It appears likely, however, that greater difference in quality exists between Oil 18 and either of Oils 16 and 17 than exists between Oils 16 and 17 themselves, and this is clearly disclosed by the C and S test. It will be noticed that all three S.A.E.-60 grade oils rate as non-corrosive (Zone I on the schedule for 30-grade oils). Nevertheless, there is sufficient variation in corrosivity for definite individual differentiation well outside the precision of the laboratory test.

TABLE 14—C and S-30 Data and Engine Data on Group IV Oils (S.A.E.-60 Grade) of the S.A.E. Crankcase Oil Stability Research Committee

	Oil Number		
	16	17	18
Cu-Pb Wt Loss, mg/cm²	0.7_2±0.1_7	0.3_5±0.1_1	0.13±0.03
Relative rank	3	2	1
Δ Neut. No. mg KOH/gm	1.8±0.6	0.3_0±0.0_5	0.1±0.0
Relative rank	3	2	1
Δ Sap. No. mg KOH/gm	11.4±0.3	$5._8$±$1._1$	0.6±0.1
Relative rank	3	2	1
Vis. inc. at 100° F, %	45±7	9.5±0.5	0-1
Relative rank	3	2	1
Naphtha insolubles, %	0.03-0.04	0.02-0.03	0.04
Relative rank	1	1	1
Over-all relative rank*	3	2	1
Over-all relative rating on basis of test engines	3	2	1
Relative service ratings	2	3	1

C and S-30 Data — See (§)

*This ranking empirically established as follows: corrosivity and naphtha insoluble rankings weighted each as unity; Δ Neut. No., Δ Sap. No. and Vis. Increase rankings weighted each as one-third.

§Report of S.A.E. Crankcase Oil Stability Research Committee (12).

Oil No.	Service Description
16	An oil of medium stability characteristics; reasonably satisfactory under a fairly wide range of operating conditions but not entirely suitable for all types of operation.
17	An oil of low stability characteristics; capable of reasonably satisfactory performance under relatively easy service conditions; distinctly unsatisfactory in high performance engines in moderately severe service.
18	An oil of high stability; superior from the standpoint of lacquer, sludge and ring sticking; possesses high stability rating over the widest possible service range.

Heavy-Duty All-Purpose Lubricants

An application in which the Corrosion and Stability Apparatus has been usefully employed is the preliminary examination of lubricants prior to protracted approval tests in heavy-duty type engines. From the experience gained thus far, it has been judged that the corrosion and stability characteristics of oils can be predicted with reasonable accuracy on the basis of the zone schedules drawn up in

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Table 4 and analysis of aged oils. Table 15 presents data on several heavy-duty, all-purpose lubricants of both S.A.E.-10 and 30 grades which have been evaluated in the C and S test and an engine test. Excellent agreement will be observed between the corrosivity predicted from the C and S test and that observed in the engine.

In some cases it will be noticed that oxidation is more severe in the laboratory test than in the engine as judged by the properties of the final oil sample. That this is most probably caused by the practice of adding make-up oil during the engine test is indicated by the properties of the sample of Oil B removed from the engine at the 384th hour of the 500 hour test. At this point, the properties of the used oil indicate greater deterioration than was obtained in the laboratory test. It is possible, in general, to obtain a useful and reasonably accurate idea of the stability characteristics of an oil from the analysis of the oil aged in the C and S tests. These used oil properties are, furthermore, helpful in accounting for the corrosiveness of an oil and in disclosing inherent weaknesses of lubricants, such as susceptibility to catalysis by metals, etc.

The utility of the C and S tests has been established through the experience gained in the examination of such lubricants as are described in Table 15. Despite the failure to correlate exactly with the engine behavior of the oils upon which extensive engine data are available, the extent of correspondence has been sufficient to invest confidence in the laboratory test. By submitting lubricants, the engine performances of which have not been evaluated, to a C and S test appropriate to its viscosity grade, it is possible to determine whether the more expensive and time-consuming engine test can profitably be run.

Correction

Attention of readers is called to the fact certain errors appeared in Part 1 of "The Corrosion and Stability Test for Lubricating Oils", in the March 1 Technical Section of NPN.

Readers who desire the corrected copy of the entire Part 1 may obtain it in reprint form by writing the Editor, Technical Section, National Petroleum News, Cleveland.

Summary and Conclusions

It has been the purpose of this communication to describe the Corrosion and Stability Apparatus and to present results obtained with it in its application as a tool useful in the laboratory evaluation of lubricants. Correlation of the results of the test with behavior of oils in various types of engines is considered to be generally satisfactory, since it must be realized that no laboratory test of this type can take into account all of the factors operative in the engine. The C and S Apparatus is simple, inexpensive, and durable; the conditions of test are such that convenient application of the test is possible for either research or control purposes. In design, the apparatus is broadly flexible and, therefore, as variations are made in engines and their conditions of operation, it should be possible to modify the test to compensate for them.

The Corrosion and Stability Apparatus has been extensively employed in these laboratories in the study of the factors affecting bearing corrosion. The effects of variation of the important physical factors, such as time, temperature, catalysis, concentration of reactants and type of bearing alloy, have been followed in the C and S. With continued advance in the fundamental knowledge in this field it is to be anticipated that instruments for the elimination of corrosion and improvement of stability can be devised on a more logical and theoretical basis than has heretofore been possible.

(*For complete bibliography see pg. R-183, March 1, 1944, Technical Section.*)

TABLE 15—Evaluation in the C and S Test of Heavy-Duty All-Purpose Lubricants

	Oil A		Oil B		Oil C	Oil D	Oil E	Oil F	Oil G	Oil H‡	Oil I‡
Viscosity Index (Dean & Davis)	100		70		100	80	90	90	90	100	87
S.A.E. Vis. Grade	30		30		30	30	30	30	30	10	10
Additive	Inhib. Deter.		Inhib. Deter.		Inhib.	Inhib. Deter.	None	Inhib. Deter.	Inhib. Deter.	Inhib. Deter.	Inhib. Deter.
Lab. Test	C and S-30		C and S-30		C and S-30	C and S-30	C and S-30	C and S-30	C and S-30	C and S-10	C and S-10
Cu-Pb Wt. Loss, mg/cm²	1.25±0.03		0.75		0.48	1.7	1.6±0.2	2.0±0.1	1.1±0.1	0.44	1.3±0.1
Final Neut. No. mg KOH/gm	1.0±0.0		0.7		0.1	0.7	1.7±0.2	0.5_5±0.0_5	0.4_5±0.0_5	0.4	0.8±0.2
Final Sap. No. mg KOH/gm	4.5		4.0		.	. . .	9.3±0.3	4.0±0.5	3±2	2.8	5±1
Vis. Inc. at 100° F, %	7.1		20		. .	19	27 ± 1	6.5±1.2	8.1±0.5	4.0	27
Naphtha Insol., %	0.01		0.02		. .	0.91	0.12±0.04	0.10±0.00	0.06±0.02	0.03	0.07
Corrosivity Rating	Zone II: borderline to mildly corrosive		Zone II: borderline to mildly corrosive		Zone I: Non-Corrosive	Zone III: Mildly corrosive to corrosive	Zone III: Mildly corrosive to corrosive	Zone IV: excessively corrosive	Zone II: borderline to mildly corrosive	Zone I: non-corrosive	Zone III: mildly corrosive to corrosive
Engine Test*	1	2	1	2	2	1	3	3	3	3	3
Cu-Pb Wt. Loss mg per ½ bearing	18	. .	. .	228	. . . .	924	5-50	42-106	12	. .	28
Final Neut. No. mg KOH/gm	. .	. .	. .	0.4 1.9†	. . . .	. . .	0.2	0.4	0.3	. .	0.6
Final Sap. No. mg KOH/gm	. .	. .	. .	2.4 4.5†	. . . .	. . .	. .	6.7	5.1	. .	4.8
Vis. Increase at 100° F, %	. .	. .	. .	11 25†	. . . .	. . .	5	11	14	. .	57
Naphtha Insoluble, %	. .	. .	. .	0.20 0.16†	. . . .	. . .	0.14	0.42	0.49	. .	0.77
Corrosivity Rating	Satisfactory	Corrosive	Satisfactory	Acceptable but mildly corrosive	Satisfactory	Corrosive	Tendency to be corrosive	Corrosive	Satisfactory	Satisfactory	Above borderline in corrosivity

*Engine Test designations: 1 Caterpillar Diesel 240-Hr. Test (2).
2 General Motors Diesel 500-Hr. Test (4).
3 Caterpillar 3-A Diesel 120-Hr. Test (2).

†Properties of lubricant sampled at 384th Hour of the 500-Hour test.
‡Oils H and I contained also a pour point depressant.

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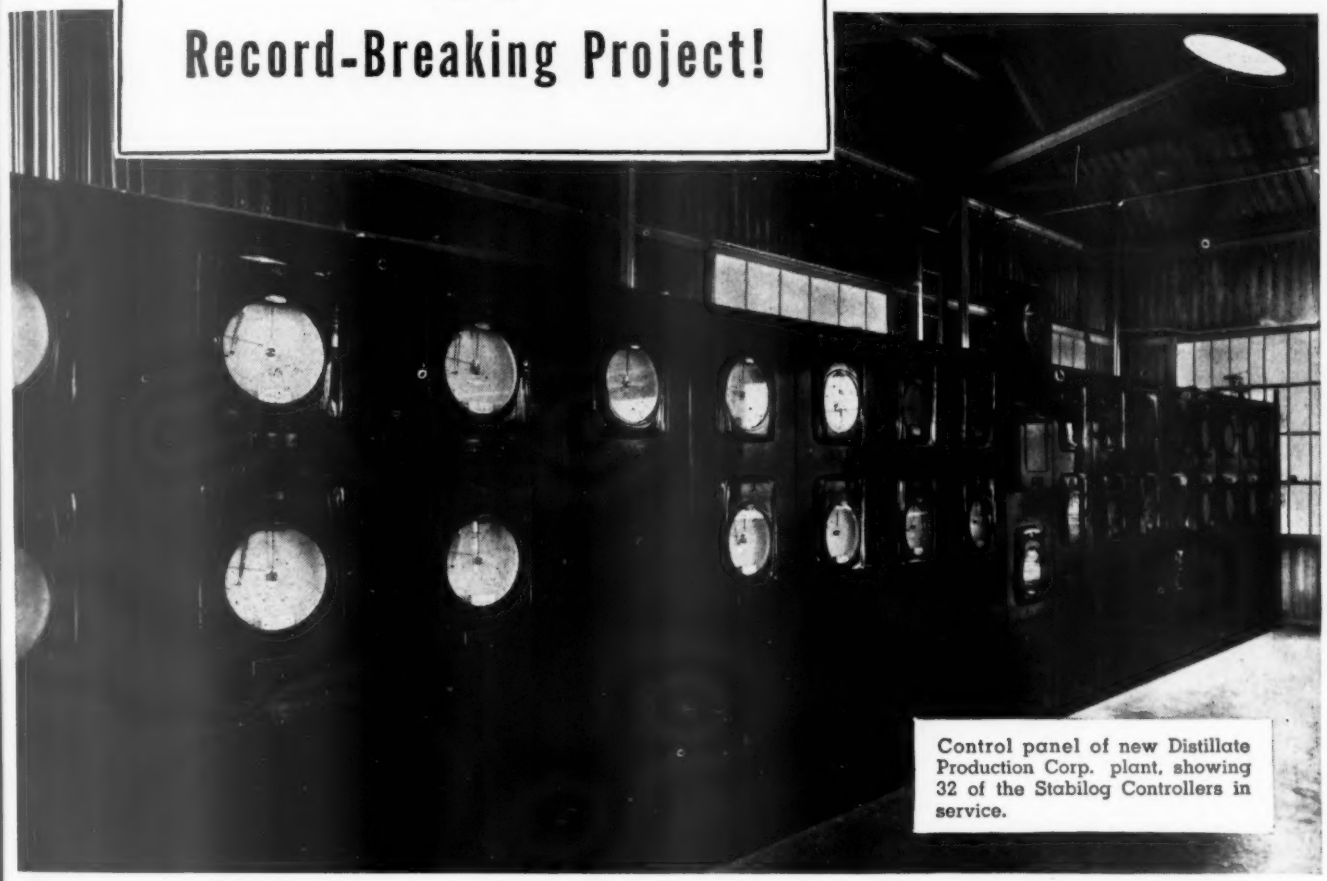

Control panel of new Distillate Production Corp. plant, showing 32 of the Stabilog Controllers in service.

Stabilog Controllers were selected by Distillate Production Corp. to help set new production "high"

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Latest Type Separator Delivers Gasoline 99.999% Water-Free

WATER coming in contact with gasoline during manufacture, transportation, or storage frequently presents a problem in the later handling of the product. The water may be in the form of an emulsion, or mechanically entrained droplets of water in gasoline.

Some systems of gasoline distribution involve water displacement from bulk storage. There generally is some water in gasoline pipelines also, which, combining with oxygen, is considered responsible for a corrosion which increases the resistance to flow in the line. Because the water may later settle out at points where its presence is undesirable, some sort of separator arrangement becomes desirable, such as on tank trucks delivering gasoline to aircraft, etc.

One of the latest types of separators to become commercially available is guaranteed by its manufacturer to deliver gasoline containing not more than 0.002% water even under abnormally high concentrations of free and emulsified water. Tests by government agencies are cited in which gasoline uniformly 99.999% water-free was delivered over long periods and at varying rates of flow. Patents have been applied for on the device.

Table Shows Efficiency

The accompanying table shows results of efficiency tests run on a 300 gal. per min. unit, using both leaded and unleaded aviation gasoline at various rates of flow. Water was continuously injected into the stream of gasoline so that it was well-dispersed before entering the separator. Under test condition "A", the water collecting in the sump was continuously drained away to prevent operation of automatic dump and cut-off controls; under condition "B", the drain was blocked and test continued until pump was shut down by action of the automatic electric safety-control when water-level in the sump reached a predetermined unsafe level.

Data reported in the table represent averages accumulated over 18 months of tests by one government agency. In that time, several million gallons of gasoline were run through the unit. Pressure drop across the unit, at full rated capacity, was 1.6 p.s.i. Still later tests, on models ranging from 80 to 200 g.p.m. rated capacity, gave the same relative efficiencies, according to the manufacturer.

Most separators contain an internal baffling system which, in conjunction with a coalescing medium, causing the finely-dispersed droplets of water to combine with others to form larger droplets until these larger droplets become big enough to settle to the separator bottom by their own weight. The only moving part of this separator is a mechanically operated water-dump valve. Pressure-drop across all sizes of the separator normally is 1.6 lb per sq. in. gage and less than 5 p.s.i. when handling large percentages of water. This drop will not increase if there are no solids contaminating the gasoline. When pressure-drop rises to 8 or 10 lb. per sq. in., indicating an accumulation of "muck" or scale, the packing can be replaced easily at nominal cost.

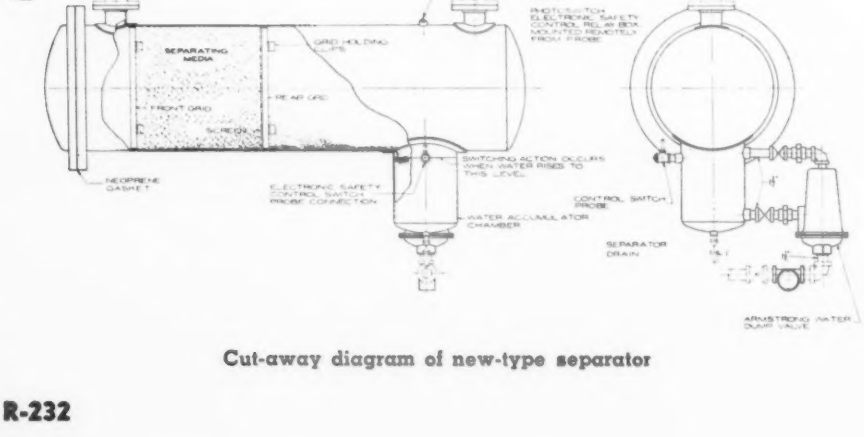
Separator Efficiency Test—Constant Water-Injection

Gasoline Flow Rate—g.p.m.	Concentration, Water —in Gasoline—% by Vol.— Entering Separator	Leaving Separator	Condition of 5-gal. Sample Bottle Before Sampling
		TEST CONDITION "A"*	
100	3.0	0.0006	Dry
150	2.0	0.0006	Inside wet with water.
300	1.0	0.0006	Dry
300	1.0	0.0039(max.)	Inside wet with water Dry bottle
400	0.76	0.0006	0.0071% by tank drain measurement.** Dry bottle
400	2.5	<0.0006	0.0074% by tank drain measurement.**
		TEST CONDITION "B"*	
50	0.38	0.0017	Inside wet with water
50	21.2	<0.0006	Dry
100	10.6	<0.0006	Dry
200	5.3	<0.0006	Inside wet with water
300	0.089	0.0006	Dry
300	3.5	<0.0006	Dry
400	2.6	<0.0006	

*A: Water continuously drained from separator to prevent operation of automatic drain control.
B: No drain of water from separator; test terminated by action of automatic electrical shut-off control.
**Best value for consideration.

the great reduction in flow-rates induced by the relatively large ratio of pipe to separator diameter, drops most of the water out of the gasoline stream. The latest type, however, while making use of the reduced flow rate effect, contains only sufficient baffling to distribute properly flow through the separator. Its operation depends on a chemically-treated excelsior-like packing for the separating action.

The packing, according to manufacturer's claims, acts both as a baffling and



Cut-away diagram of new-type separator

Externally, the separator is not unusual, being essentially a horizontal cylindrical vessel having top inlet and discharge connections and a water-leg or sump under the discharge connection with a water-dump line connection. Internally, construction is unconventional. Fluid entering the separator encounters a chamber of comparatively large diameter with reference to inlet line, which reduces flow rates to a low value. From this chamber fluid enters the "coalescing zone" or "contact chamber" through baffles which serve to distribute it evenly throughout the cross-section of the water-separating medium and to keep this in place.

Settling Chamber Described

The coalescing chamber is packed with a chemically-treated excelsior-like material, which, it is said, causes even the finest water-gasoline emulsions to break and form droplets sufficiently large to fall by gravity to the bottom of the chamber. This material also acts as a mechanical filter, entrapping solid particles much as do hay-tanks in pipeline practice. Exit from this chamber is through a screen which prevents any of the packed material (inserted at a specified density) from migrating into the settling chamber.

The settling chamber is similar to that of many horizontal separators, but it con-

tains no baffles. It is included in the settler proper merely to give sufficient time for all coalesced water-droplets to fall out of the gasoline phase and to prevent water-carry-over into the discharge by mechanical entrainment. At the end of this chamber is the discharge, at the top, and underneath is located the water-leg or sump where separated water accumulates.

Automatic Water Dump Valve Described

The sump has a float-controlled dump valve, which opens periodically as separated water reaches a predetermined height and closes when the minimal level is reached. This float-valve is simple in construction, embodying a globular float enclosed in vertical guides and connected to the dump-valve itself by a lever-type linkage. The float is counter-weighted so as to operate on the difference in the specific gravities of gasoline and water. This mechanism is the only moving part of the separator. As an added protection in the event flow becomes 100% water, or large slugs of water are received, an electronically controlled safety switch may be included in the water sump. When water reaches a height sufficient to affect this switch, the pumps feeding the separator are automatically shut down, and, if desired, will sound a simultaneous warning to the operator. It can be so connected that, when waterlevel in the sump has dropped to a safe point, it will re-start the pumps. Or, restarting the pumps may be left to manual operation, as desired.

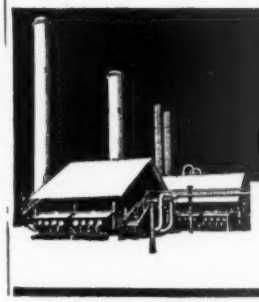
The inlet-end of the separator is a flanged convex head, bolted to the separator body. A working-space of 4 ft. is recommended for repacking operations. Packing itself, which costs from $5 to $20 for units ranging from 25 to 1000 g.p.m., is supplied in cartons and packed loosely into the contact chamber behind the distributing baffles, which also are removable for this operation. Old packing is discarded. The chemical treatment of the excelsior-like material of which the packing consists is guaranteed not to catalyze gum-formation in separated products. If the gasoline is free of solids, packing should last indefinitely without replacement.

Supplied in Different Sizes and Designs

The manufacturer, The Warner Lewis Co., of Tulsa and Washington, regularly supplies sizes from 25 to 1000 g.p.m. Working pressures range from 50 to 150 p.s.i.

Special designs are available for installing on tank trucks, and larger sizes or sizes for working pressures in excess of 150 p.s.i. can be furnished. The unit also can be used to separate water from light distillates, with efficiency of separation varying with gravity and viscosity of the product in question. Investigations also are under way to improve separation-efficiency for liquids heavier than gasoline and naphthas.

Recognition of the power of fire is typified by ancient fire worship practices. As fire became subjugated to the will of man, it became the tool of civilization, rather than the symbol of awesome religion. The power of fire for usefulness is typified by its control for the purposes of modern petroleum processing. Pioneering in heat research and in the engineering application of heat to the many necessities of the industry, Alcorn has designed and erected furnaces which have resulted in lower operating costs and higher production efficiency in many world important refineries. Alcorn's 20 years experience, continued research and knowledge of the new techniques of the industry are at your service.



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R-233

Methods of Compounding Barium Greases, Their Properties, Uses and Future*

Greases prepared from a complex soap made by reacting normal barium soap with excess barium hydroxide under controlled conditions were found to possess water and heat resistance and other desirable properties. The properties of these complex barium soap greases have enabled them to be used as all-purpose greases in many industrial as well as automotive applications. Methods of compounding are presented, together with the properties and uses of this type of grease.

*By L. W. McLennan***

DURING the past 15 years the grease industry has witnessed a number of valuable and progressive developments which clearly reveal a vitality within the industry itself as well as suggest an interesting and promising future. These developments have related both to the improved formulation of the more conventional greases, such as those thickened with aluminum, calcium and sodium soaps, and to more significant testing methods for evaluating these same lubricants.

During the same period, the introduction of several entirely new types of greases has also represented a contribution of considerable interest and importance. Of these new types, the barium and lithium soap-thickened lubricants are probably the most widely known and used. This paper is concerned specifically with the barium soap greases and its purpose is to present in adequate detail the methods of compounding these greases, their properties, uses and future possibilities.

It will be recalled that until recent years the three principal types of greases marketed by the trade were those prepared with the calcium, sodium or aluminum soaps as oil thickeners. Except in a limited degree, none of these greases combine all the principal desirable properties of an all-purpose grease. The lubricants thickened with sodium soap exhibit little resistance to the emulsifying action of water but in general, provided water is not present, do furnish acceptable lubrication at elevated temperatures. The common calcium soap greases are relatively resistant to the action of water, but normally cannot be used safely at elevated temperatures either because they are too fluid at temperatures above approximately 150 deg. F. or because at temperatures approaching 200 deg. F. the loss of water of hydration results in separation of oil and soap.

Through the judicious combination of other soaps with sodium soap, the use of viscous oils or special fats in the manufacture of sodium soap greases, or through the use of high boiling organic compounds, etc., in the case of calcium greases, the cited defects of the two classes of greases can be mitigated but not entirely eliminated. The aluminum base greases combine water and heat resistance to an interesting degree, but these greases, unless appropriately modified, often possess objectionable gel structures at elevated temperatures, precluding their satisfactory use at such temperatures.

A few years ago consideration was given to the possibility that barium might form soaps that would thicken mineral oil and yield all-purpose greases providing high-temperature lubrication as well as water resistance. The greases originally contemplated were those containing normal soaps such as are used in the case of calcium base greases. The few references in the literature indicated that normal barium soap greases of acceptable quality had never been prepared successfully. Nevertheless, it was considered worthwhile to re-investigate the problem, and initial attempts to produce these greases consisted in using a procedure similar to that currently employed for the ordinary lime soap greases.

The results of the above investigation were unexpected and extremely interesting. It was found that, while relatively stable normal barium soap greases could be prepared, they required water for their stabilization and consequently did not possess sufficient advantages over calcium soap greases in respect to dropping point, temperature susceptibility and stability to justify manufacture. However, during the investigation the discovery was made that under certain conditions excess barium hydroxide would react with normal barium soap to yield a complex soap which in turn would thicken mineral oils and yield the desired water and heat-resistant grease. Full information upon the subject was disclosed in two patents(1) covering the composition and compounding procedures of the aforementioned greases.

After an extended study of the service performance of the above "complex" barium greases and the development of suitable methods for commercial manufacture, it was found possible to market the grease as a regular product and to produce it with the same personnel and equipment as were used for the more conventional sodium and calcium soap greases. Since that time, for over 6 years, the complex barium soap greases have been marketed regularly in increasing volume and their performance in service has fulfilled expectations.

The following presents a detailed discussion of manufacturing methods, properties, current uses, and future possibilities of complex barium soap greases.

Preparation of Commercial Barium Soap Greases

The commercial preparation of complex barium soap greases is given in broad form with extensive detail in the two patents(1) cited above, but the following outline covers the salient features of one of the preferred methods:

The appropriate fat or fatty mixture, such as prime tallow, and the barium hydroxide (usually in the form of barium hydroxide octahydrate) in specified excess amounts are charged to a jacketed kettle equipped with an agitator and supplied with 110-120 lb. steam. While being agitated, the mass is heated to a temperature somewhat above the boiling point of water, e.g. 214°F., for a time sufficient to allow completion of the saponification process.

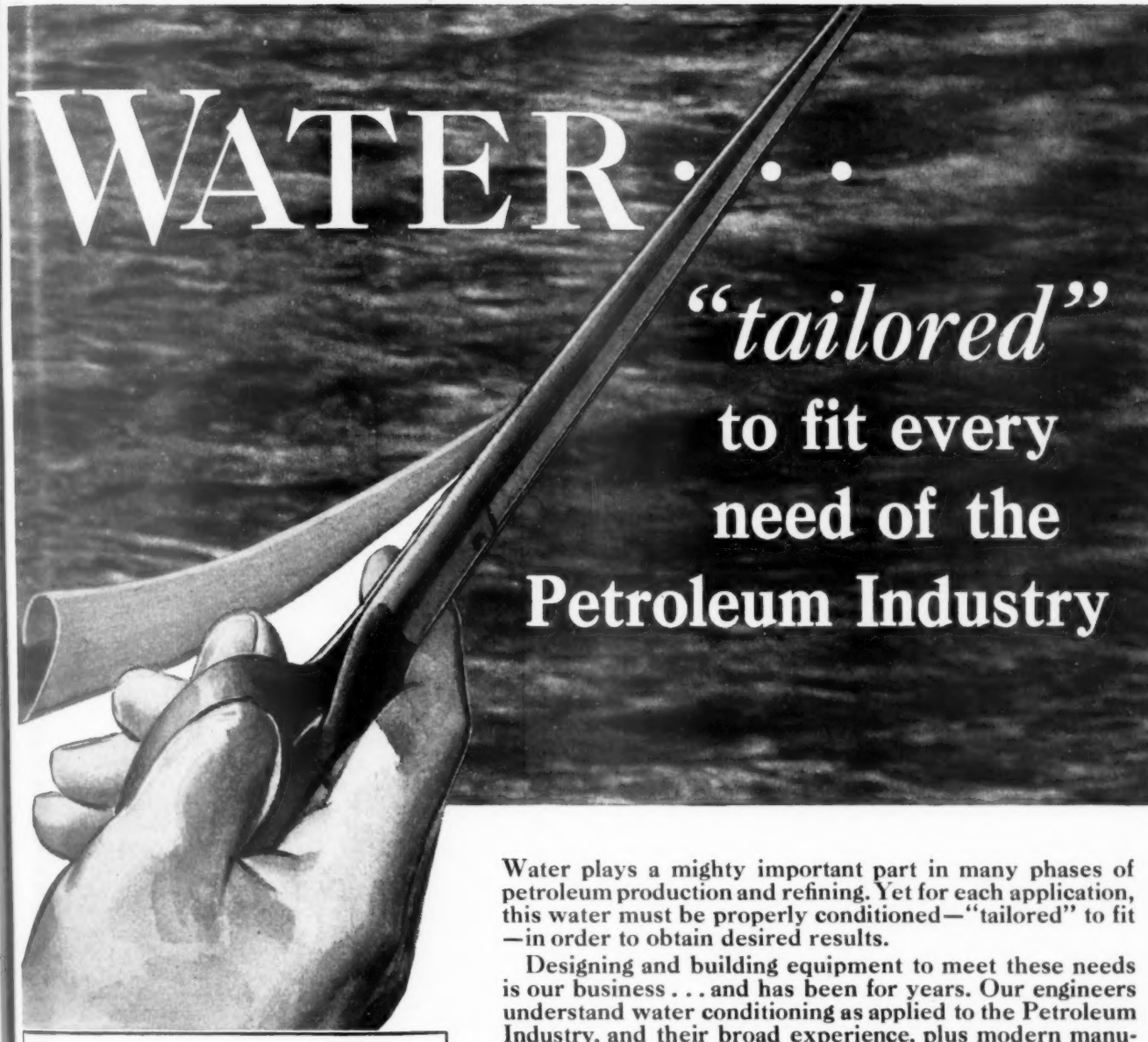
After the fat has been saponified, which is a matter of a relatively few minutes, heating of the batch is continued and approximately half of the mineral oil is slowly incorporated in the soap mass. During this heating period, the temperature of the kettle contents will have risen to about 310-340°F. When the temperature is in the latter range, the formation of the complex soap from the normal barium soap and the excess barium hydroxide begins and proceeds vigorously. This reaction is exothermic and the temperature should be restricted to 375°F. or lower by the introduction of water into the kettle jacket or by the addition of oil to the soap mass, if necessary.

Finishing the Grease

When the free barium hydroxide content has reached a value of about 0.50%, the remainder of the oil is added with constant stirring as rapidly as it can be accepted by the kettle contents. From this point on, the grease may be finished in a number of ways, one commonly used method being to cool the grease below 210°F. and add a small quantity of water (0.2% to 3.0%). The grease is then partially dehydrated at an elevated temperature to develop the proper grease body, drawn into pans, cooled, and subsequently worked or

*Presented under the title "Barium Grease" before National Lubricating Grease Institute, Chicago, Nov. 1-3, 1943. Published in the Institute Spokesman, March and April, 1944, issues.

**Union Oil Co. of California, Wilmington, Calif.



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homogenized to bring it to a smooth non-fibrous consistency.

Barium greases have been prepared from a wide variety of soap stocks, such as tallow, lard oil, cottonseed oil, horse fat and the like, combinations of these with one another or with fatty acids.

The barium hydroxide is readily available in commercial quantities as the hydrate, $Ba(OH)_2{\cdot}8H_2O$. The amount of excess barium hydroxide used in compounding complex greases can be varied within a generous range, e.g. 40-60%, the particular range depending partly upon the kind of grease desired, upon the viscosity of the mineral oil present, etc.

Latitude in formulation is also possible in regard to the type and viscosity of the mineral oil used. A grease prepared with a naphthenic lubricating oil of 500 sec. Saybolt Universal at 100°F., for example, has given very satisfactory performance as a general-purpose lubricant. Valuable greases have also been prepared containing oils of higher and lower viscosity. Satisfactory greases have likewise been compounded from oils of widely varying types and in this respect, the formulating of barium greases is comparable with that of the more common greases containing calcium or sodium soaps.

The water content may be varied considerably, since it is not critical as in the case of many other greases. It is desired only to keep the water content low enough to insure suitably high melting points, acceptable appearance and good performance for prolonged periods at elevated temperatures.

Finally, as to variations in the actual compounding procedure used, in most respects there is ample leeway as to operations without the quality of the product being affected. Consequently, the correction of any irregularity in a batch operation presents no more serious problem than in the case of the more conventional greases.

Properties of Complex Barium Soap Greases

The commercial barium soap greases of the complex type are unctuous, thoroughly milled greases of non-fibrous or buttery texture, which resemble in appearance the calcium soap greases of generally comparable composition. The following data are typical for one of the barium soap greases being extensively marketed at the present time on the Pacific Coast:

Barium soap, %	22.0
Free alkali, %	0.05
Free fat, %	0.3
Water, %	0.15
Unsaponifiable matter, including mineral oil and glycerin (by diff.)	77.50
Total, %	100.00
ASTM penetration at 77°F. (unworked)	240-260
ASTM penetration at 77°F. (worked)	240-260
ASTM dropping point, °F.	350+

It will be noted that the soap content is appreciably higher than that of the sodium and calcium soap greases and considerably higher than that of the lithium and aluminum soap greases of comparable ASTM penetration. Although it is recognized that the question of soap content versus lubricating efficiency is a controversial subject in the grease industry, it is believed that the long record of eminently satisfactory lubrication performance, frequently under adverse conditions where no other grease was adequate, is sufficient evidence that high soap content is not a detriment in so far as barium greases are concerned. Further, it is felt that a comparison between different types of greases solely upon the basis of soap content is rather a pointless argument unless proper cognizance is taken of the differences in the molecular weights of the bases, of the ultimate effectiveness of the greases in lubricating bearing surfaces under service conditions, and of the various factors of composition that radically modify the oil-thickening action of the different soaps.

Free Alkalinity Maintained

The free alkalinity or free acidity of the grease is maintained as near neutrality as practical, a free alkali content of approximately 0.05% being considered typical. However, as is often observed, a slight amount of free acidity imparts added stability to the grease without evident objectionable effects.

A glycerin content seems to be desirable, and it has been found preferable to employ a quantity of the straight glycerides as a portion of the soap stock along with a moderate percentage of fatty acids. A water content also seems to be desirable, such as 0.1%. However, it has been found that, depending upon the soap stocks employed, good greases may possess water contents of 0.4%.

The A. S. T. M. penetration of the commercial barium grease is not subject to marked change upon further working, either in the ASTM grease worker or in high speed bearings, because it is already severely milled before being packaged. In this respect, it is very similar to the familiar sodium soap ball-bearing greases distributed in the trade. Moreover, these two types of greases also undergo approximately the same degree of breakdown in penetration during the same severe milling operation, a fact which is of interest from the viewpoint of high temperature lubrication.

Milled barium greases frequently exhibit an anomalous effect in that they actually harden appreciably upon being worked in the ASTM grease worker, instead of showing the customary breakdown. Because the milled barium soap grease, like the usual milled sodium soap greases, does not exhibit excessive breakdown in grease structure upon being further severely worked, it is particularly effective in lubricating bearings involving excessive mechanical agitation, for example, wheel bearings.

The A. S. T. M. dropping point of the barium soap grease, it will be noted, exceeds 350°F. However, normally these greases have not been recommended for continued use when temperatures are in excess of about 250°F. This is due to the fact that maintaining the present barium greases at temperatures of about 300°F. or higher for prolonged periods causes a gradual change in structure leading to eventual degradation of the grease body. On the other hand, if the normal bearing temperature is below 250°F. but due to some cause or other peaks of 300°F. or higher are encountered for relatively short periods of time, satisfactory lubrication is obtained and there is no tendency for the grease to melt and run out of the bearing. In special cases it has been possible to give continued effective lubrication at temperatures in excess of 250°F.

The high water resistance of the barium soap greases is particularly important, because this property and the high heat resistance represent two of the principal reasons why these greases can be employed advantageously as all-purpose lubricants. No standard test is available for evaluating greases in respect to their water resistance. However, of the various laboratory tests currently employed for the purpose, it is thought that the Navy water absorption and leaching tests (Specification 14L5) are probably to be preferred for indicating in a preliminary way and with a fair degree of assurance, approximately what can be expected from the respective greases in actual service, particularly when vigorous mechanical agitation is a factor.

By these tests, the barium, calcium and lithium soap greases are comparable in respect to their water resistance. If other tests, such as boiling water tests and the like, are employed, essentially the same general grouping of the various type greases will result. The water resistance of the greases will be affected considerably by the hardness and the composition of the grease, depending for instance upon the amount of soap present, presence of glycerin, viscosity of the oil, etc. All of the barium soap greases prepared to date have shown acceptable water resistance when tested by the commonly used procedures for evaluating greases in respect to this particular property. Service performance has strikingly confirmed the results of such tests.

The heat resistance of the commercial barium soap greases is another property of major interest. From the method of manufacture and from the fact that the barium soap greases do not undergo a radical change in physical structure when

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Edison said it takes more perspiration than inspiration to get results

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heated to high temperatures (above 225°F.) and then recooled, it will be evident that this type of grease should manifest a very favorable heat resistance under service conditions. In fact, barium and sodium soap greases behave similarly in this respect. Other commonly used greases, when heated to elevated temperatures and recooled, either become unstable because of loss of water or show a marked and undesirable change in physical structure. Further, the physical structure of still other types of greases, although moderately satisfactory for lubricating high speed bearings at ordinary temperatures, breaks down as a consequence of mechanical working at elevated temperatures.

The relative temperature susceptibility of greases is frequently represented by penetration data at various temperatures. This method of comparison, as in the case of the A. S. T. M. dropping point, can lead to serious misunderstandings unless allowance is made for the changes in the physical structures of the greases at elevated temperatures. For example, merely to cite the penetration data for heavily gelling aluminum greases at 140-200°F. would be misleading unless it were also understood that such greases possessed a viscous gel structure making such a product, unless modified, unsatisfactory for lubrication at these temperatures.

In the case of sodium, calcium, and barium soap greases, however, data of this kind can be presented so that one may gain a reasonably accurate impression of how such greases change in penetration and appearance with temperature. The data in Table 1 indicate how the above 3 types of greases compare in respect to their temperature-consistency coefficients over a wide range of temperature.

The comparative behavior of the greases as indicated by the above data can be qualitatively confirmed by merely heating or cooling samples of the 4 greases simultaneously and stirring the samples with a thermometer to note the temperatures and relative hardnesses of the greases. It is clear from these data that the 3 types of greases thin out at approximately the same rate over a wide temperature range, and it is of particular interest to note that between 0°F. and 240°F., the consistencies of both the barium and sodium soap greases change in a generally comparable manner. An interesting comparison of the above greases could probably also be drawn from pressure viscosity data obtained through the use of a pressure viscosimeter similar to the apparatus[3] described at a previous convention (1942).

A discussion of the heat resistance of barium grease properly includes comments relative to its oxidation resistance. The Norma-Hoffman oxidation bomb test is the most widely used method of determining the oxidation resistance of greases. Although it may be difficult to correlate the test data with full service performance, it is believed that the test differentiates relatively good greases from inferior products. Using this bomb test at 210°F., with glass trays, without catalyst, and with 110 lb. per square inch of oxygen, complex barium soap greases showed an induction period of 96 hours.

This result compares favorably with those for other uninhibited greases prepared from similar quality soap stocks and mineral oil. Moreover, the residue from the test was similar to that remaining from sodium soap greases after the same test; it was slightly harder and darker than the original grease but otherwise unchanged. This oxidation test is a severe one, and other type greases without inhibitors will frequently show serious syneresis, liquefaction, or an objectionable change in grease structure. The use of oxidation inhibitors in barium greases will extend the induction period as in the case of other greases.

The low temperature properties of a barium grease, as for other greases, are dependent to a considerable degree upon the viscosity and the viscosity index of the oil with which it is made. From Table 1, it is evident that at low temperatures, barium soap greases harden in the same manner as calcium or sodium greases containing oils of similar quality. By using oil of appropriately low viscosity and of high viscosity index, it has been possible to prepare a barium soap grease which lubricates effectively at bearing temperatures of approximately —40°F.

The stability of barium soap grease, in relation to syneresis of the grease in storage or in use, is a question of importance to manufacturer and user alike. Reasonable care in the formulation manufacture of these greases has resulted in the regular production of stable lubricants equal in quality to the commonly marketed aluminum, calcium and sodium greases, as judged by a modified Herschel test[4] or by other bleeding tests, such as that described in the Navy Department Specification 14L5. A sample of the initial commercial production of barium grease, after being stored in the original container for 6 years, is still entirely free from evidence of syneresis.

Extensive ball bearing tests on barium soap greases and other common type greases in the Navy Grease Machine and also in a refrigerated laboratory bearing tester have permitted a careful comparison of the bearing performances of the greases in question. The results of these tests are in general agreement with experience in using the greases under actual service conditions. Where bearing speeds, temperatures and loads are moderate, the sodium, calcium and barium greases all appear to provide satisfactory service, with the use of the barium soap grease resulting in excellent grease retention, grease seals, running torques, and bearing temperatures.

At elevated temperatures (e.g. 175-225°F.) where, as far as is known among the regularly marketed greases, only the sodium and barium greases can function effectively, these two greases perform in a generally comparable manner in respect to grease retention, grease residues, grease seals, torque values, bearing temperatures, and the absence of aeration. Where bearing temperatures run considerably in excess of 225-250°F. or where bearing speeds exceed 3600 rpm at elevated temperatures, certain carefully selected sodium soap greases furnish more effective lubrication.

If, however, moisture can come into contact with the grease, then the barium soap grease will prove superior to the sodium grease and, in fact, will possibly be the only satisfactory grease available for use under such conditions. This combination of water resistance and a relatively high degree of heat resistance has proved singularly useful in lubricating bearings where the effects of heat, humidity, and mechanical working conjointly have resulted in an unusually difficult lubrication problem.

The tendency of greases to aerate badly in service, particularly in high speed bearings, is considered detrimental in that the aerated grease more readily leaks from a bearing and, under particularly severe conditions, it is probable that accelerated oxidation also results. Barium soap greases, as in the case of the sodium greases, appear to be relatively free from this objectionable property.

The present commercial barium greases exhibit an unusual tenacity or adhesiveness for metal surfaces and highly resist the displacing action of water. Consequently they have been found ef-

TABLE 1—Temperature-Consistency Coefficients of Three Types of Greases

Type of Grease	Abraham Consistency(2) (worked grease) 0°F.	40°F.	77°F.	100°F.	140°F.	180°F.	240°F.	300°F.
Calcium—(Pale)	3.1	2.9	2.8	2.6	2.5	..	..	..
Calcium—(Black)	3.9	3.1	2.9	2.8	2.6	2.1	.	..
Barium	3.7	3.4	3.2	3.0	2.6	2.5	2.2	.
Sodium (Short fibre)	3.3	3.1	2.8	2.7	2.4	2.3	2.4*	2.2

*This hardening effect has also been observed with other samples of sodium greases.

All four greases represent regularly marketed products prepared with a soap stock, of which at least 85% is prime tallow, or a mixture of prime tallow and tallow fatty acids. With the exception of the grease shown as calcium (pale), the greases were prepared with oils varying from 55 to 70 sec. Saybolt Universal at 210°F. The calcium (pale) grease was prepared with an oil possessing a Saybolt Universal Visc. of 42 sec. at 210°F. Abraham consistency data are presented here rather than ASTM penetration data, merely because the original tests were more conveniently made using this test, and direct conversion of the data to ASTM penetration cannot accurately be made. For those not conversant with this test, it is pointed out that progressively higher values represent a hardening of the grease.

fective as rust preventives where metal surfaces, e.g. bearing surfaces, steel plates, etc., may be exposed continuously to moisture or salt water.

The Uses of Complex Barium Soap Greases

It will be evident from the foregoing description of the preparation and properties of greases containing complex barium soaps that the peculiar virtue of this type of lubricant resides principally in the following combination of properties:

1. A high degree of resistance of the deteriorating effect of water.
2. The ability to maintain a good grease structure upon exposure to high temperatures.
3. The property of maintaining grease structure under severe mechanical working.
4. An unusual adhesivenes, compared with many other common type greases of similar composition, for metal surfaces.

This unusual combination of properties qualifies the grease as an all-purpose lubricant capable of fulfilling a wide variety of highly specialized services. However, because the present commercial greases have been formulated as all-purpose lubricants and because the possibilities of the available experimental products have not been thoroughly exploited as yet, tne full potentialities of the complex barium greases are not completely known at this time. New and interesting applications for the greases are continually being found.

The present commercial barium greases have been used for many purposes of lubrication where in each instance the more conventional type greases could be applied at least equally well as for example on chassis bearings, wheel bearings, water pumps, motor bearings, track rollers, and the like. However, none of these conventional greases can be effectively used as a general-purpose lubricant for all the aforementioned services. As far as is known, barium grease is the only widely established commercial product that will serve efficiently as a single all-purpose grease.

At the present time, for example, a number of the large trucking companies throughout the Pacific Coast states are using the grease as a general-purpose all-season lubricant on truck chassis, wheel bearings, water pumps, etc. These trucks operate over one of the most mountainous regions of the U. S. throughout the entire year. Consequently the equipment is exposed to a wide range of temperature and humidity. Another example of similar use is the case of a southern California utility company that employs the grease as a general lubricant on the wheel bearings, chassis, water pumps, and track rollers of a fleet of 300 units which operate in low and high atmospheric temperatures, on the desert and in the mountains.

Many mining companies throughout the western states employ the grease on equipment exposed in an intermittent manner to all conditions of weather and to high temperatures in the vicinity of the furnaces. Specifically, barium greases have been used for the lubrication of bearings on conveyors, cars, shaker equipment, roasters, motors, classifiers, crushers, cranes, tuggers, cable drums, etc. On a number of occasions, the use of a single grade of grease has permitted dispensing with as many as 5 different greases previously used to provide the same service.

An outstanding performance of this grease occurred at a Nevada smelter of one of the major copper companies. The problem involved the lubrication of bearings on a conveyor moving blister copper from the furnace to the cooler. Because of the heat from the copper slabs, the steam and moisture attendant to the dousing of the slab for cooling, and the operation of a section of the conveyor under water at 200°F., satisfactory lubrication of the equipment presented a difficult problem. Of 32 greases tested, barium grease was the only one found satisfactory for the purpose. Lubrication costs were cut to one-quarter and the frequency of lubrication reduced from twice daily to once every four days.

Dredging companies, irrigation districts, and flood control organizations frequently encounter severe lubricating problems with their equipment, including drag lines, water pumps, drive shafts, bucket ladders, cable drums, tractors, etc. Complications arise because many of the bearings operating at high temperatures are periodically exposed to moisture on account of the nature of the operations or of the weather. Barium grease provides adequate lubrication under these conditions. At the same time, the grease also fully protects the bearing surfaces on the above equipment against corrosion by water and against abrasion by the sand or dust that is constantly present. Still another important advantage consists in the fact that only one grease, instead of 4 or 5, is needed by an operator for lubricating his equipment.

In the plants of the packing or canning companies, the versatility of barium grease has been utilized in a valuable manner. It is a necessary practice in these plants to clean the equipment thoroughly at regular intervals during each operating day with water, steam, and detergent. In addition, many of the bearings on the machines operate at 175-200°F. and low speeds in a wet atmosphere, or at slightly lower temperatures and high speeds in a humid atmosphere. Under these conditions, it is essential that the lubricant used in the bearings be both water-and-heat-resistant and protect the bearing surfaces against corrosion, and that it should not be displaced from the bearing during the regular washing down operation with steam, water, and detergent. Furthermore, in some of the plants, as for example the Hawaiian units operating on pineapple pack, the severely corrosive action of certain fruit juices has always been a matter of major concern, and any grease that offers exceptional protection against corrosion is of unquestionable value to the trade. In all of the foregoing services, barium grease has been used with highly gratifying results.

One of the more impressive uses of the barium grease to date has been the lubrication of the roller bearings on a 9.6-mile long conveyor system for moving aggregate at Shasta Dam near Redding, Cal. On the main conveyor and plant lines there are in all approximately 85,000 bearings. Much of the equipment, including the conveyor, is exposed to atmospheric temperatures ranging from 10°F. to 130°F. throughout the year. The rainfall at times during the winter months is very heavy. In addition, dust and sand are always present in the vicinity of the bearings. During the past 3½ years, these bearings have been satisfactorily lubricated with one of the present commercial barium greases.

(A short section of the original paper describing other specific applications of barium greases and their use for protecting metal surfaces against corrosion is omitted here for lack of space.—Ed.)

Future Possibilities

The possibilities in respect to the further development and use of barium soap greases may be viewed with distinct optimism. During the past six years, the amount of barium grease marketed by one Pacific Coast oil company has steadily increased until at present only the tractor and chassis lubricants surpass it in sales volume. It is anticipated that additional commercial barium soap greases will eventually be available for certain special uses, for example on aircraft bearings and in bearings operating at abnormally high speeds. Current experimental work indicates that a substantial reduction in soap content should also be realized. Such improvements should increase further the value of these complex barium soap greases for the purpose of general lubrication.

In the meantime, when a customer requests only one grease for a number of highly different services or wishes only one grease on his premises, the type of barium grease described in this paper is definitely the most satisfactory answer that one large grease manufacturer has been able to offer to date.

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Revivification of "B" Solution for Wet Foam Fire Extinguishing Systems

The basic or "B" solution used in the wet foam fire extinguishing systems for oil tank fires loses its effectiveness in time through the breaking down of the sodium bicarbonate in the solution to normal sodium carbonate. A means is presented for revivifying the normal carbonate to sodium bicarbonate in the required concentration by the addition of carbon dioxide in the form of dry ice. Costs of the method are compared with the cost of replacing the basic solution with fresh ingredients. The relative efficiencies of the closed or pressure method of revivifying with the open or non-pressure method are discussed.

*By Arthur Fox Holler**

FIRE PROTECTION equipment must be selected from a consideration of the potential risk of plant involved, plant value, public liability, cost of fire prevention or fire fighting equipment and effectiveness of the equipment.

Foam fire extinguishing equipment is usually used for liquid fires, particularly in the petroleum industry. Foam floats on most liquid surfaces, thereby smothering the flame and preventing the contact with sufficient air to support combustion. Quoting from National Safety Council Pamphlet No. 24, "The blanket of foam persists for some time and prevents re-ignition of the fire from outside sources. Foam extinguishers are considered effective on both Class "A" and Class "B" fires. However, foam extinguishers are relatively ineffective on fires in such liquids as alcohol, acetone and lacquer thinners such as butyl and amyl acetates which break down the foam.

"Carbon disulphide and ether have low boiling points so, when foam is applied to fire in these liquids, the vapors may continue to penetrate the foam blanket and burn above it. Carbon disulphide and ether also break down the foam considerably. The effectiveness of foam is reduced when applied to very hot liquids such as boiling linseed oil. Foam is a conductor of electricity and is especially dangerous if applied to live apparatus."

There are two types of foam systems in common use: The dry system and the wet system. The dry system consists of a generator used to mix two dry chemicals "A" and "B" with water in a hopper, thereby forming foam which is carried by the water pressure through a pipe line to the fire. A dry system sometimes utilizes two pipe lines bringing the solutions from the generator together at a point near the fire and thereby mixing the foam at that point to eliminate breakdown of the foam bubbles in the line.

The wet system consists of tankage containing two solutions: The one is an acid solution of approximately 13% aluminum sulphate [$Al_2(BO_4)_3 \cdot 18\ H_2O$] and 87% water. The other is the basic or "B" solution consisting of approximately 3% stabilizer (wet basis), 8% sodium bicarbonate ($NaHCO_3$) and 91% water. When these two solutions are mixed by means of pumps and pipe lines, foam is generated at the point of contact of the two solutions.

Bicarbonate Breaks Down

This paper does not attempt to elaborate on the various types of both dry and wet foam systems or the merits of either system, but treats on the basic "B" solution used in the wet system. There are many wet foam systems existent or to be erected in various manufacturing and refining plants, storage plants, and at points of concentration of quantities of hazardous liquids and greases. It is a known fact that the sodium bicarbonate ($NaHCO_3$) breaks down during a period of time to normal sodium carbonate (Na_2CO_3), carbon dioxide (CO_2) and water (H_2O), thereby losing its effectiveness in the formation of foam. The foam desired consists of small bubbles containing carbon dioxide and is about 7 to 9 times the volume of the original solution. It is essential in order to obtain the expansion and the texture of the foam that the proper percentage of sodium bicarbonate be maintained in the "B" solution.

Efficiency, therefore, dictates that the original "B" solution be replaced with new solution when a sufficient percentage of the sodium bicarbonate changes to normal carbonate; or that the original batch be revivified by converting the normal carbonate to sodium bicarbonate to a concentration of approximately 8% by the addition of carbon dioxide. It is essential that the reaction be studied in order to determine the amount of carbon dioxide to be added.

Normal carbonate plus carbon dioxide plus water yields sodium bicarbonate:

$$Na_2CO_3 + CO_2 + H_2O \rightarrow 2NaHCO_3$$

In order to determine the amount of sodium bicarbonate the normal carbonate present will produce when fully combined with CO_2 one must determine the molecular weight of normal (sodium) carbonate equivalent to the molecular weight of sodium bicarbonate. One part of normal carbonate is equivalent to two parts of sodium bicarbonate. *See Table* 1.

It was previously stated that CO_2 gradually escapes as a gas, thereby breaking down the sodium bicarbonate in the basic solution. The reaction is reversible by replacing the CO_2 gas and the sodium carbonate is converted to sodium bicarbonate.

Analysis Is Necessary

It is first necessary to analyze the "B" solution in question to determine the percentages of normal sodium carbonate and sodium bicarbonate. The sample tested was found to contain 4.3% of Na_2CO_3, 2.8% of $NaHCO_3$ with a specific gravity at 78°F. of 1.0670. The tank capacity was 56,400 gal. and contained approximately 50,329 gal. of solution. In order to determine the weight of CO_2 required it was necessary to find the weight of solution—50,329 gal.

$$(50{,}329)\ 1.067\ (8.3) = 445{,}635 \text{ lbs.}$$

One must know the percentage of normal carbonate in the solution to be converted to bicarbonate to determine the amount of CO_2 required. This percentage is found by balancing the molecular weights of Na_2CO_3 and $NaHCO_3$:

$$(\%\ Na_2CO_3) : X = 106 : 168$$

Where X = % $NaHCO_3$ produced when the % Na_2CO_3 is fully combined with CO_2.

First consider converting the total percentage of Na_2CO_3 present in the solution:

$$4.3 : X = 106 : 168$$

$$X = \frac{(4.3)\ 168}{106} = 6.81\% \text{ of } NaHCO_3$$

To this amount is added the 2.8% of $NaHCO_3$ originally in the solution,

$$6.81 + 2.8 = 9.61\%\ NaHCO_3.$$

Freshly mixed solution contains 8% bicarbonate plus the equivalent of .6% bicarbonate introduced in the stabilizer or a total of 8.6%. The amount of Na_2CO_3 to be converted to obtain a total of 8.6% of bicarbonate is determined as follows:

$$8.6 - 2.8 = 5.8\% NaHCO_3$$

$$\%Na_2CO_3 : 5.8 = 106 : 168$$

$$\%Na_2Co_3 = \frac{(5.8)\ 106}{168} = 3.65$$

The resultant would indicate that a

Table 1—Molecular Weights of Normal Carbonate and Sodium Bicarbonate

Na_2CO_3	Identical with	$2NaHCO_3$
46—Na_2 (2 atoms sodium x 23)		46—2 Na (2 atoms sodium x 23)
12—C (1 atom carbon)		2—2 H (2 atoms hydrogen x 1)
48—O_3 (3 atoms oxygen x 16)		24—2 C (2 atoms carbon x 12)
		96—2 O_3 (6 atoms oxygen x 16)
106—molecular weight of normal carbonate		168—Two times the molecular weight of sodium bicarbonate

Considering 23 molecules per atom of sodium, 12 molecules per atom carbon, 16 molecules per atom of oxygen, 1 molecule per atom of hydrogen.

*Staff Assistant in Charge of Construction and Maintenance, Standard Oil Co. of Pennsylvania.

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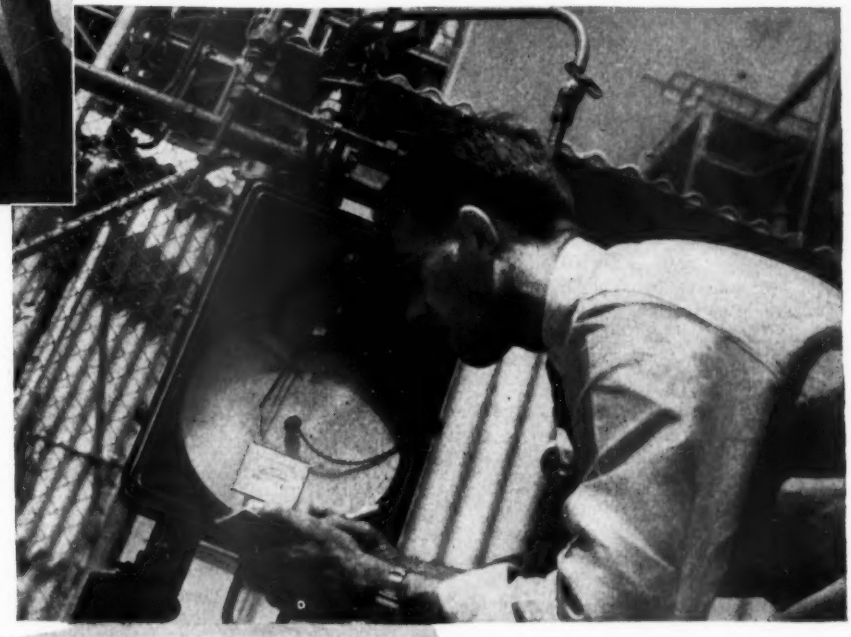

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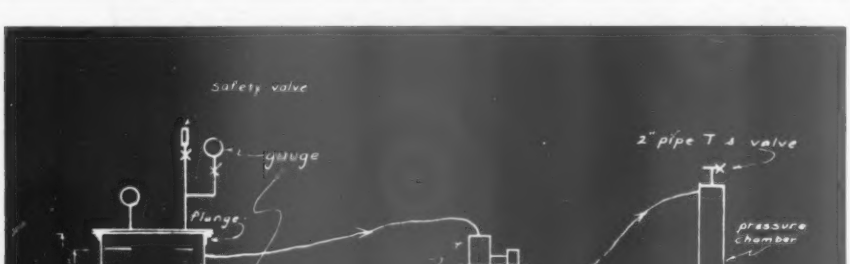

Fig. 1—Sketch of laboratory equipment used in revivification of "B" fire foam solution

total of 3.65% of normal carbonate should be converted to bicarbonate to obtain the same bicarbonate content as freshly mixed solution.

It has already been shown that the weight of the solution in the tank is 445,768 lbs., of which amount 3.65% normal carbonate is to be converted to bicarbonate;
(445,768) .0365 = 16270.53 lbs. Na_2CO_3 to be converted.

It is known from the molecular weights that 44 lbs. of CO_2 are required for every 106 lbs. of Na_2CO_3 for conversion:

$$\frac{(16270.53)\ 44}{106} = 6753.8 \text{ lbs. } CO_2$$

Discussion of Costs

This resultant gives us the approximate amount of fully combined CO_2 required to revivify the 50,329 gal. of solution. It is, of course, desirable to provide fire protection as well as any other plant unit at the least cost and with the least maintenance expense. Depreciated Basic foam solution can be replaced with a new batch mixed with new ingredients, or the depreciated solution can be revivified to a desired value by the absorption of CO_2. Revivification can be accomplished by the use of inert gas from refinery operations or other sources, Co_2 gas cylinders or dry ice in either the pressure method or open method. It would, therefore, appear that the cheapest method should be determined by the process of elimination.

In order to mix 50,000 gals. of new solution the ingredients at present market prices would cost a minimum of $1477 without considering the cost of labor to mix. It is obvious that this amount is prohibitive when compared with revivification costs.

Inert refinery gas is automatically eliminated for use in strengthening an old solution because the supply is not available in most instances.

The use of CO_2 gas cylinders in this instance, would require 135 cylinders (100% absorption), at $3 per cylinder, delivered, or $405.

The required 6753 lbs. of dry ice (100% absorption) at 3c per lb. would cost $203. It is apparent the CO_2 in the form of dry ice is desirable from the view point of cost of the gas but it is necessary to ascertain the method of absorption which will provide the required strength of solution at the least total cost.

Determining Efficiency

The closed or pressure method of revivifying has been in use for some time but little information is available concerning the efficiency or cost of the open or non-pressure method. The writer proceeded to conduct laboratory experiments to determine the efficiency of the non-pressure method versus the pressure method.

The first test was conducted in the field using an open mixing kettle connected with circulating lines to the Basic solution storage tank. The kettle was partially filled with 1000 gals. of base stock from the storage tank (4.3% Na_2CO_3, 2.8% $NaHCO_3$, sp. gr. 1.067) and circulated during the experiment.

Fifty pounds of dry ice were added at 15-minute intervals and the top of the kettle was covered with a canvas to prevent excessive escape of the gas. A total of 200 lbs. of dry ice was added and the solution circulated for 45 minutes after the last cake of dry ice was placed. At this point very little boiling on the surface of the solution was noticeable. An analysis after this revivification showed 2.6% Na_2CO_3 and 5.6% $NaHCO_3$. An expansion test gave 8.5 expansions in volume and after half an hour the foam retained a 5½ volume expansion. It was evident from this test that the open or non-pressure method could be used but it was questionable if an approximation of 8% $NaHCO_3$ could be attained—at least with an economical amount of dry ice.

Laboratory equipment was made up to simulate equipment in the field which would enable personnel to conduct experiments in utilizing first, a vented tank with no pressure and no circulation; second, a vented tank with no pressure but circulating the solution during absorption; third, a closed tank and circulating lines operating under pressure and circulating during absorption. The laboratory equipment consisted of a piece of steel line-pipe with welded bottom and roof for the field storage tank, a pressure absorption chamber of steel pipe with brick rip-rap baffles, circulating lines of copper tubing and a Tuthill circulating pump (5 gals. in 12 min.) with a ½ hp. motor. All equipment was built to scale.

The storage tank was filled to the same proportionate height as the B solution field tank and the solution used was taken from the B solution field tank. (See Fig. 1) Table 2 is descriptive of the experiments and the resultants.

Listing Additional Features

It is evident that the pressure method is more efficient but it is desired to prove by this paper that the cost of the additional dry ice (non-pressure vs. pressure) is less than the cost of pressure field equipment and the labor involved. Additional features of the non-pressure method are: time element, less labor, no capital expenditures for equipment and the elimination of the hazard due to pressure operation. Table 2 indicates that the non-pressure-non-circulation method is more efficient than the non-pressure-with-circulation method. Additional tests were conducted (No. 1 J to No. 1 M) to show that approximately 8.6% of $NaHCO_3$ could be obtained by the addition of dry ice.

The non-pressure-non-circulation method was, therefore, utilized in the field, using dry ice to revivify 49,446 gals of basic foam solution. This operation used a total of 10,605 lbs. of dry ice with a total cost of $318 for the CO_2 actually used plus $121 for labor, or a total cost of $439. It can be seen from Table 3 that the analysis of the final revivified solution was 7.5% $NaHCO_3$, 1.5% Na_2CO_3 and 1.066 sp. gr. A foaming test of this final "B" solution with "A" solution produced a good quality of foam. (Note, some dry ice was wasted.)

Some valuable facts learned in the final field revivification were:

1—Approximately one and a half hours required to dissolve 1 block of dry ice.

2—Block of dry ice suspended less than 10 ft. from top of liquid in tank will cause excessive loss of gas; suspended more than 10 ft. from top will reduce gas loss.

3—Dry ice blocks resting on bottom of tank will cause violent action of liquid.

4—Paper, etc. will freeze to dry ice blocks when handling in wet weather; blocks will freeze together.

5—Blocks vary in weight from 43 to 66 lbs.

6—Average weight of 204 blocks was 51.9 lbs.

7—Amount of dry ice lost due to

evaporation and breakage was 721 lbs.

8—Dry ice added faster than 4 blocks per hour causes excessive large bubbles of escaping gas and the gas collects in clouds immediately above the liquid surface near the tank shell.

9—Smell of gas is easily detected at top man-hole if the rate of addition exceeded 4 blocks per hour; otherwise smell is not perceptible. Small gas bubbles and no cloud collection at shell of tank.

10—No visible escape of gas through tank pressure vent. (½ oz. per sq. in.)

11—Manhole on top of tank covered except when adding blocks or checking reactions.

12—Tank should be circulated before taking base stock sample at beginning of test.

It is apparent from Table 3 that the final percentage of $NaHCO_3$ obtained was 7.5 approaching the desired 8 + %. The foam formed by mixing the revivified solution with the acid solution was very satisfactory in every respect.

One last determination remains to finally decide the superiority of the non-pressure method versus the pressure method: namely, the lower cost of materials, equipment and labor.

New calculations to revivify the final quantity of 49,446.1 gals. of solution to the final 7.5% $NaHCO_3$ indicates 5430 lbs. CO_2 100% absorption. Therefore, since 10,605 lbs. of dry ice were used with the non-pressure method the consumption was 195% of the required. The total cost of material and labor (no extra equipment necessary) was $439.

Tests by Imperial Oil

Considering revivifications conducted in the field by Imperial Oil Ltd. in 1939 using the pressure method, it was found that a minimum of 115% of the theoretical required dry ice was actually consumed. (Final 7.65% $NaHCO_3$.)

As a comparison, using the minimum 115% CO_2 for the pressure method to revivify 49,446 gals. to 7.5% $NaHCO_3$, (field test in question) would consume 6245 lbs. of dry ice at .031c lb. = $187.35. However, the pressure equipment developed by Imperial Oil including pressure absorption drums, relief valves, gauges, pipe lines, labor and overhead at today's prices cost $1272. Analyzing the cost of revivifying by the pressure method it is necessary to ship the equipment from plant to plant, erect the drums, lines and pump and later dismantle same at an estimated cost of $334. Therefore, the pressure method for the test presented would have cost $521 plus the amortization of the equipment prorated per job.

It appears to the writer upon consideration of all the conditions outlined in this paper that the non-pressure method of revivification of basic foam solution is the cheapest, quickest and most satisfactory for present day conditions.

Table 2—Summary of Laboratory Tests of Revivification of "B" Foam Solution

Test No.	Sp. Grav.	Normal sodium carbonate Na_2CO_3 %	Sodium bi-carbonate $NaHCO_3$ %	Quant. Gals.	Lbs. dry ice	Temp. On °F.	Temp. Off °F.	Time On	Time Off		Foam Test	Conditions of Test
Base Stock	1.0670	4.3	3.0	..	..	78		.....		(Original)	Yes	
1A	1.0677	3.7	3.9	3⅝	.75	66	54	11:48	12:15			
1B	1.0681	3.4	4.4	3⅝	.5	54	50	12:20	12:47			
1C	1.0685	3.1	4.9	3⅝	.5	56	50	2:55	3:24			No pressure
1D	1.0685	2.8	5.4	3⅝	.5	50	48	3:29	3:56			No circulation
1E	1.0689	2.5	5.9	3⅝	.5	48	46	4:00	4:27			
1F	1.0689	2.3	6.2	3⅝	.5	46	45	4:29	4:52			
1G	1.0689	2.2	6.4	3⅝	.5	45	44	4:55	5:14		Yes	
Note: Additional Tests Run on Adding Dry Ice.					Total 3.75							
1J	1.0694	1.7	7.0	3⅝	2.00	36	34	12:35	1:32			No pressure
1L	1.0686	0.6	8.6	3⅝	2.00	34	30	2:37	3:25			No circulation
1M	1.0694	0.2	9.5	3⅝	1.00	30	30	3:28	4:13			
					Total 8.75							
Base Stock	1.0689	4.7	2.6	..	..	78		.....		(Original)	Yes	
2A	1.0677	4.3	3.1	3⅝	.75	66	60	9:42	10:04			
2B	1.0677	3.9	3.8	3⅝	.5	60	58	10:09	10:26			
2C	1.0685	3.7	4.1	3⅝	.5	58	56	10:30	10:55			Circulation
2D	1.0681	3.5	4.3	3⅝	.5	56	53	10:59	11:12			No pressure
2E	1.0681	3.3	4.7	3⅝	.5	53	50	11:18	11:32			
2F	1.0689	3.0	5.0	3⅝	.5	54	52	12:42	1:03			
2G	1.0685	2.7	5.5	3⅝	.5	52	50	1:07	1:32		Yes	
					Total 3.75							
Base same as above										Pres. Lbs.		
3A	1.0681	3.3	4.7	4	.75	66	62	9:52	10:30	110 Max.		
3B	1.0685	3.0	5.0	4	.5	62	63	10:45	1:00	110 Max.		Pressure and
3C	1.0689	2.7	5.6	4	.5	63	66	1:19	4:19	110 Max.	Yes	Circulation
3D	1.0693	2.3	6.3	4	.5	60	60	1:22	3:10	110 Max.	Yes	
3E	1.0701	2.0	6.8	4	.5	60	60	3:28	5:40	110 Max.		
3F	1.0713	1.6	7.4	4	.5	58	66	9:38	2:45	110 Max.	Yes	
					Total 3.25							

Table 3—Results of Tests on Revivifying Basic Foam Solution in 20 x 24 ft. Field Tank, by Non-Pressure, Non-Circulating Method.

Test No.	Spec. Grav.	Sodium carbonate Na_2CO_3 %	Sodium bi-carbonate $NaHCO_3$ %	Quant. in Tank*	Gauge of Tank Inage	Temp of Air °F	Temp. of Product °F	Pounds of Dry Ice Per Day	Blocks of Dry Ice Per Day	Time Start a.m.	Time Stop p.m.
A-1	1.064	4.6	2.6	(Base Stock)				None	None		
A-2	1.065	4.3	3.2	49 446	21'½"	78	70	1038	20	11:20	4:00
A-3	1.065	3.8	4.0	49 540	21'1"	82	73	1357	26	9:30	3:45
A-4	1.065	3.6	4.3	49 634	21'1½"	70	70	1310	26	9:30	3:45
A-5	1.065	3.1	5.0	49 728	21'2"	55	67	1406	26	9:30	3:45
A-6	1.065	2.5	5.8	49 893	21'2¾"	74	68	1320	26	10:00	4:15
A-7	1.066	2.3	6.4	49 987	21'3¼"	75	66	1359	26	9:30	3:45
A-8	1.066	1.8	7.1	50 034	21'3½"	70	66	1342	26	9:30	3:45
A-9	1.066	1.5	7.5	50 127	21'4"	75	67	1473	28	9:30	4:15
							Total	10605			

* Quantity revivified varies from original gauge due to withdrawals

Recent Advances in the Processing And Utilization of Plastics

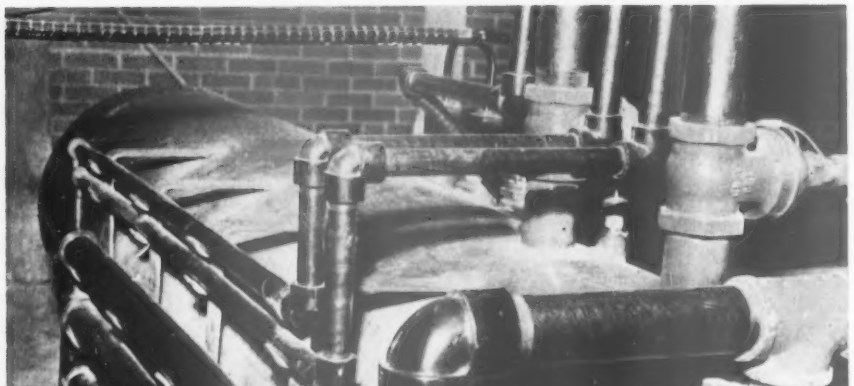

Photo: Courtesy The Dow Chemical Co.

Saran pipe (vinyl and vinylidine chloride copolymer) is shown used in heat exchanger unit in a Dow Chemical Co. plant. Although resistant to water, weak acids, weak alkalies, brine, straight chain alcohols, aromatic hydrocarbons, nitroparaffins, Saran is thermoplastic and softens under influence of heat and pressure

The petroleum industry is directly concerned with developments in the field of plastics, both as a supplier of raw materials for their manufacture and as a user of finished products.

Spurred by wartime shortages of critical metals, this development has been rapid the past few years, particularly in the application of plastics in industry. Molded parts are being produced to dimensional tolerances previously considered impracticable. Cellulose plastics have been developed that are resistant to both freezing and boiling water. Laminated plastics are finding new uses, particularly in aircraft. As testing methods improve and further data on the physical properties of various plastics become more available, further progress along these lines will result.

Recent improvements in the processing and utilization of all kinds of plastics and in testing methods were presented at the Plastics Symposium held Feb. 22 and 23 by the American Society for Testing Materials in Philadelphia. Indications of trends in the plastic industry and important developments, as shown in the papers presented before the symposium, are given in the accompanying article, written exclusively for NPN. Edwin L. Cline, the author, is engaged in research work on this subject at the Mellon Institute of Industrial Research.

*By Edwin L. Cline**

THE current popularity of plastics was evidenced by capacity crowds assembled for both sessions of the Symposium on Plastics sponsored by the American Society for Testing Materials in Philadelphia the evenings of Feb. 22 and 23. Thanks to close adherence to a rigorous time schedule, a mass of technical data was presented in a short time. Discussion from the floor was somewhat curtailed but will be supplemented by written comments.

The petroleum industry is interested in the developments reported from two standpoints. First, plastics will be used more extensively in the production and refining of petroleum. The industry now uses laminated phenolic piston rings and pistons in compressors and pumps, and a few other applications have been found for thermoplastic materials. The petroleum engineer should give further consideration to the use of plastics.

However, the major interest of the petroleum industry in plastics should be as supplier of the constantly expanding requirements of raw materials for plastics manufacture. Such materials as acetic anhydride for the cellulosic plastics, ethylene for the vinyls and polystyrene, propylene for the allyl plastics and the acrylates, even alkylated phenols for phenolics; all are available from petroleum sources. As petroleum refining becomes more and more a chemical industry let us hope that the outlets for plastics' raw materials may compete, as a source of profits, with automotive and aircraft markets.

The Philadelphia symposium was divided into two sections. The first evening was devoted to a discussion of the development of various testing methods intended to provide data necessary for evaluation of plastics for engineering applications. During the second evening several papers along similar lines were presented. Dr. Gordon M. Kline of the National Bureau of Standards then delivered in summarized form a series of papers prepared by experts in the field on the properties, uses, and salient features of families of plastics. The authors of the individual papers were present for the subsequent discussion.

It is not proposed to discuss in this article the technical details of the individual papers. For details we refer you to the book of complete proceedings to be published by the society. It is believed that our readers would be more interested in a condensed picture of the subject matter of the symposium coupled with indications of the trends in the

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plastics industry and the more important recent developments.

Plastics have often been referred to as glamorous materials. Reams of advertising copy have been written around their beauty. Many people have gotten the impression that the principal value of plastics arose from esthetic appeal. The fact that plastics originally were employed because they possessed desirable physical properties has not been emphasized. The early development of celluloid billiard balls certainly was based on desirable mechanical properties rather than beauty. The successful application of Bakelite distributor heads for internal combustion engines depended on desirable electrical properties coupled with the required mechanical strength.

Now there is no doubt that eye appeal will result in ever increasing sales of articles of singular beauty, fabricated of plastics and worthy of every adjective the advertising men can find in their extensive glossary. It took a war with the accompanying search for substitute materials to bring plastics to the attention of design engineers as materials whose strength-weight ratio was favorable for mechanical and structural applications. Now the engineering field bids fair to become a major outlet for plastics.

But what of the data necessary for engineering calculations so essential in successful design? Very little was available a short time ago. Under the pressure of war time urgency plastics were used in many installations. Some applications were successful. A great many failures resulting from lack of adequate information served to give plastics a bad name in some quarters. The designer needed to know how plastics would behave in a variety of environments under various conditions of stress. He had at his finger-tips relatively complete information on metals. With the possible exception of creep strength figures, those data have been available for years. Corrosion data were plentiful and where not available could be obtained through standardized tests. The supply of similar data on plastics available in trade literature and handbooks was meagre. Manufacturers of plastics working in conjunction with committees of engineering societies inaugurated research programs to develop test methods applicable to plastics. As a result the designer is now being supplied with the information that he needs. There will still be failures. No laboratory test is infallible. Service tests will continue to give the final answer. What we can expect is a greater proportion of successful engineering applications of plastics resulting from design based on adequate test data.

In discussing material in the papers delivered at the symposium it appears to be advisable to cover the last group of papers first, since these papers review the properties, uses, and salient features of families of plastics, and it is assumed that the information given will serve as a refresher course for readers. The papers of this group were delivered in summarized form by Dr. Kline. The names of the authors of the individual papers are listed with the titles.

1. The Phenolic Materials, Molded and Laminated

By W. A. Evans, The Bell Telephone Laboratories, New York.

Phenolic plastics belong to the group called thermosetting resins. The value of thermosetting resins arises from the fact that they can be prepared in fusible, soluble form, then be converted into infusible, insoluble form by the application of heat and pressure. For example, fusible resin powder may be ground with a filler, say wood flour or asbestos, and the mixture heated and compressed in a mold to form a finished molded product. Or a fusible, soluble phenolic may be dissolved in a solvent and the resulting varnish used to impregnate paper or fabric. After evaporation of solvent several layers of the impregnated material may be heated under pressure to form a laminated phenolic product.

Although not included in the paper we might add here the phenolic casting resins and adhesives both of which have assumed importance in the war program. Casting resins and adhesives are also prepared in soluble, fusible form and then converted to the insoluble, infusible state. The conversion may be carried out with heat or pressure or both.

Recent developments which have assumed importance in the phenolic resin field include new materials as well as improved molding technique. New casting resins have found use in the manufacture of blocks, jigs, and mandrels for shaping sheet metal. Good mechanical properties, low shrinkage factor, and good aging behavior are responsible for this successful application. The casting of phenolic resins differs from casting of metals. Metals need only be melted, poured into a mold and allowed to cool and solidify. Phenolic casting resins are prepared in liquid form, mixed with a catalyst just prior to use, then poured into a mold and heated for a period of two to 12 hours. Under the influence of the catalyst the liquid resin is converted by chemical change into the solid infusible form. Prior to the war, casting resins were used in the fabrication of many articles of gem-like beauty. With the pressure of wartime demand for substitute materials, phenolic casting resins were modified to produce an excellent product for engineering applications.

Phenolic resin adhesives are widely employed in the preparation of plywood for aircraft construction, building materials, and other engineering applications. The adhesives are available in liquid, solid, and film form. All depend on chemical change for conversion to the infusible, insoluble stage. Mildly acid catalysts have been used in the past to avoid deleterious effect on wood. Recently, an improved phenolic adhesive with a mildly alkaline reaction has been introduced. It should find ready markets.

Photo: Courtesy The Dow Chemical Co.

Canteens, resistant to both freezing and boiling water, non-corrosive, extremely light and free of telltale metallic clank, are now being made from ethylcellulose. This plastic is outstanding for toughness (especially at low temperatures), dimensional stability and resistance to alkalies

The significance of recent improvements in the method of applying heat to thermosetting resins cannot be over-emphasized. The use of high frequency electrostatic heating, also called electronic heating, is spreading rapidly throughout the industry. In applying heat to a thick section of a plastic or of plastic bonded plywood ordinary contact methods are at a disadvantage because of the low heat conductivity of the materials. A long time of heating is necessary to raise temperatures in the center of the piece to the range essential for cure. Electronic heating, on the other hand, is distributed uniformly throughout the piece and yields strong, thoroughly cured products in a short time. Postwar utilization of this method on a large scale is to be expected. A new resistance method of heating applicable especially to plywood has been developed in Canada. In this method a conductor of electricity is incorporated in the adhesive. Then current is passed through the glue line to effect conversion of the adhesive to the insolu-

Photo: Courtesy of Resistoflex Corp.

Shoes coated with Compar (vinyl resin derivative) resist destructive action of oil, kerosine, other petroleum solvents

ble form. This development is now approaching commercial stage and may become important in the fabrication of large articles such as aircraft propeller blade blanks.

Necessity is the mother of invention and the introduction of low-pressure laminating may well be attributed to wartime shortage of equipment for the customary high-pressure technique. Results have exceeded the fondest expectations of the original investigators. Pressures may range from mere contact pressure to 250 lb. per sq. in. Molds are inexpensive, and the products are satisfactory for many wartime applications.

2. Urea and Melamine-Formaldehyde Plastics

By Ladislav Boor, American Cyanamid Co., Stamford, Conn.

The urea and melamine formaldehyde plastics are thermosetting materials. Methods for utilization of these materials are similar to those employed for phenolic plastics. The outstanding features of the urea-formaldehyde moldings are brilliance and permanence of color, lack of odor and taste, speed of molding, and good electrical characteristics. They find wartime use in the form of buttons, plywood adhesives and waterproofing agents for fiber containers. The melamine-formaldehyde resins are superior to the urea-formaldehyde type in resistance to abrasion, heat, the action of water, acid and alkalies. A recent successful application is the utilization of mineral filled melamine plastic for distributor heads for aircraft engines, where this type of plastic exhibits superior electrical properties. This application will extend into the postwar field. Alpha-cellulose and chopped fabric-filled materials now used for buttons, trays, and heavyduty tableware may find postwar outlet in the fabrication of consumer goods.

3. Vinyl Plastics

By H. L. Drukker, Carbide and Carbon Chemicals Corp., New York.

The vinyl plastics are available chiefly as derivatives of vinyl acetate, vinyl alcohol, vinyl chloride and vinylidene chloride. Many of the commercial resins are co-polymers, that is they are obtained by polymerization of a mixture of two or more of the components listed. With the exception of the polyvinyl butyrals, which are available in thermosetting grades, the vinyl plastics are thermoplastic. Thermoplastics soften under the influence of heat and pressure without undergoing chemical change. They may be calendered, extruded, molded, formed under heat and pressure, or laminated. They are available as rigid materials or may be plasticized to yield rubber-like properties. Successful wartime applications of vinyl plastics are too numerous to list here. They have been widely used for many purposes and will continue to be valuable materials in the postwar period.

4. Allyl Plastics

By Franklyn Strain, Columbia Chemicals Division, Pittsburgh Plate Glass Co., Barberton, O.

The allyl plastics are a new group of thermosetting materials prepared from allyl alcohol. They are useful in casting and in laminating. Cast sheets have superior optical clarity, resistance to abrasion, to solvents, to heat, and to crazing when compared with other plastics. Simple shapes may be formed from cast sheets but complicated shapes must be cast directly. It has been stated that allyl plastics would have had wide use in aircraft enclosures if the development had been at a more advanced stage at the outset of the war. Fabrics laminated with allyl plastics are cured at low pressures and require inexpensive equipment. Certain of the laminates, particularly those prepared from fiberglas, exhibit mechanical properties superior to the light metals. Limited supply of allyl alcohol has restricted the use of allyl plastics to a few important military applications, but extensive use may develop after the war.

5. Cellulose Plastics

By W. E. Gloor, Hercules Powder Co., Parlin, N. J.

The cellulose plastics were used extensively before the war, and are perhaps the best known of the thermoplastic families. The manifold uses are apparent on all sides. Toughness is an outstanding characteristic. A tendency to absorb moisture is an inherent weakness that has been difficult to overcome. Cellulose acetate is widely used as a sheet material. The nitrate, commonly known as celluloid finds use in fountain pens, hammer heads and many other applications. Cellulose acetate-butyrate shows good outdoor weathering characteristics and is used in fabrication by extrusion of various aircraft and automobile fittings. The latest addition to the family, ethylcellulose, is outstanding for toughness (especially at low temperatures), dimensional stability, and resistance to alkalies.

Information concerning many military uses is restricted. A recent application as equipment for the armed forces is a canteen resistant to freezing as well as boiling water. A few specialized rubber-like plastics are based on highly plasticized ethylcellulose. A plastic based on ethylcellulose has found use as a material for constructing dies used in forming sheet metal. Cellulose plastics are in a constant stage of development. A plastic boat mentioned in accounts of the Aleutian fighting is based on a new laminated structure. A tough sheeting with clarity equalling that of the acrylics may be expected as a future development. The use of cellulose plastics will be on the increase in the postwar period.

6. The Polystyrene Family

By W. C. Goggin, Dow Chemical Co., Midland, Mich.

Polystyrene, a relative newcomer to the thermoplastic group, has been available only for military applications and even then only in restricted quantities. Styrene is an important ingredient of synthetic rubber and of course that use has had first call on the supply. Excellent electrical properties are the outstanding feature of the polystyrene family. A recent development of importance is the production of polystyrene film. This film owes its superior tensile strength to a stretching process which produces orientation of the molecules. Polystyrene will be available in large quantities at a low price after the war. We may expect large scale utilization of this plastic in many fields.

7. The Acrylates

By William F. Bartoe, Rohm & Haas Company, Philadelphia.

The acrylates, a prominent family of thermoplastic resins, are best known for their wide utilization in aircraft enclosures. They are derived from the esters of acrylic and methacrylic acid. They may be stretched, formed and molded. Production of cast sheet was increased greatly in 1943 and with this increase there has been an extension of available sizes of these sheets particularly in thicknesses over one-quarter inch. Extensive postwar utilization is expected.

1. Effect of Environmental Conditions on Mechanical Properties of Plastics

By T. S. Carswell and H. K. Nason, Monsanto Chemical Co., Springfield, Mass.

This subject is significant in that it demonstrates the type of information now demanded by the engineer as a

prerequisite to the utilization of plastics in engineering design work. We must determine the effect of temperature, humidity, contact with chemicals and weathering on such properties as tensile, flexural, compressive and shear strength, on stiffness and rigidity, on ductility, on shock resistance, on creep and stress endurance, on fatigue resistance, dimensional stability, and physical integrity.

Temperature is extremely important, even more than in the case of metals, for plastics show significant change in properties over a relatively short temperature range. Humidity does not affect metals but may seriously affect a plastic.

2. Stiffness and Brittleness Properties of Non-Rigid Vinyl Chloride-Acetate Compounds

By R. F. Clash, Jr. & R. M. Berg, Bakelite Corp., Bound Brook, N. J.

The authors found a correlation between stiffness in flexure and stiffness in torsion for a number of elastomers based on plasticized polyvinyl acetate-chloride copolymers. Temperature effect on stiffness was shown graphically for several compositions.

For Further Data—

Readers interested in obtaining more detailed information on any of the papers abstracted in this article, or the complete report of the proceedings, should address the Secretary-Treasurer, American Society for Testing Materials, 260 S. Broad St., Philadelphia 2, Penna.

3. The Behavior of Plastics Under Repeated Stress

By B. J. Lazan and A. Yorgiadis, Sonnbag Scientific Corp., Greenwich, Conn.

The authors stressed the importance of fatigue tests in evaluating plastics for engineering applications. The individual tests discussed resemble those employed in determining fatigue strength of metals. Advantages and disadvantages of the various methods were brought out and further investigation was suggested. Fatigue tests are of particular importance in the selection of materials which will be used in applications where vibration will be encountered.

4. Diffusion of Water Through Plastics

By J. Deeg, Jr. and C. J. Frosh, Bell Telephone Laboratories, Murray Hill, N. J.

In a study of diffusion of water through plastics the authors found that data taken under any particular set of humidity conditions are not indicative of the behavior of the plastic over a wide range of humidity conditions. For engineering purposes the rate of moisture diffusion must be integrated over the entire moisture range to be encountered in any application in order to select the proper plastic composition (e.g. for sealing purposes).

5. Testing in Connection with Development of Strong Plastics for Aircraft

By Henry Sang, Naval Air Experimental Station, Philadelphia.

The thermosetting laminates appear to have properties approaching those required of aircraft structural metals. However, in general most of the laminates can be made to compare favorably with the metals only by the use of strong reinforcements and special processing techniques. Although some standard test methods were used in evaluating plastics for aircraft structural requirements deviation was made from Federal Specification L.P. 406 in method of defining yield strength in tension, compression and flexure; and the procedure in the fatigue test. Other procedures still in the development stage were also employed. The tests described are indicative of the rigid inspection a material must undergo before it can be accepted by the Naval Air Experimental Station.

NEW BOOKS FOR THE REFINER

Data on Aviation Gasoline Manufacture Compiled

What is, as far as this reviewer is informed, the most complete collection of the available and non-restricted data on aviation gasoline has been gathered together in "Aviation Gasoline Manufacture", by Matthew Van Winkle. The purpose of the book, states the preface, "is to summarize the available information concerning the manufacture of aviation gasoline in such form that it will serve as a reference for those who are interested in this field of refining, and to develop a fundamental discussion of aviation gasoline manufacture presented in a logical sequence that will serve as a textbook" for students and others unfamiliar with the subject. A careful search of current periodical literature and familiarity with recent discussions before professional societies is evident in the preparation of the book.

The author is now instructor in chemical engineering at the University of Michigan and was formerly assistant professor and supervisor of the petroleum and natural gas extension division of Pennsylvania State College. The work is one of the Mineral Industries Series published by the latter institution.

Beginning with a brief summary of the history and development of aviation gasoline, dating from 1903, the book traces changes, from the time when aviation and motor fuels were synonymous and left much to be desired, to 1942, discussing specifications and methods of manufacture as well as development of methods of test. Among the nine chapters are six on "Hydrocarbons in Aviation Fuel and Aviation-Fuel Manufacture", "Production of Aviation-Fuel Base Stocks", "Manufacture of High-Antiknock Hydrocarbons", "Production of Finished Aviation Gasolines", "Special Aviation Fuels and Aviation-Fuel Components", and "Performance of Aviation Gasolines". The appendix is devoted exclusively to a discussion of current test methods for the evaluation of aviation fuels. A nine-page subject index supplements the text matter of 266 pages.

The book may be obtained postpaid from the Book Department, NATIONAL PETROLEUM NEWS, 1213 W. 3d Street, Cleveland 13, Ohio, for $3.

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Principles of Industrial Lubrication Described

"Lubrication of Industrial and Marine Machinery", by William G. Forbes, describes and analyzes the problems in lubricating machinery which daily confront engineers and technicians.

Unlike the solutions to most engineering problems, the author states, there are very few convenient formulas that will provide rule-of-thumb answers in the practice of lubrication engineering. The fund of information that has been accumulated on this subject is largely the result of practical experience with trial-and-error methods, and the various discussions in the text are presented without resort to involved theories or mathematical analyses.

Early chapters deal with the fundamentals of distillation, cracking, refining and petroleum chemistry. This is followed by discussions of tests and specifications for lubricating oils; effect of heat, pressure and metals; mechanics of lubrication, and methods for applying lubricants. Fully half of the text is devoted to the principles of lubrication covering the more prevalent types of engines, machines and major industries. Although every type of mechanical operation is not included, the principles which are explained and developed can readily be applied to special machinery and equipment.

The index, as is far too often the case with books that the technical man should add to his reference library, leaves something to be desired in the way of completeness. But that's a minor point, and "Lubrication of Industrial and Marine Machinery" covers the subject thoroughly in its 314 pages. Copies may be obtained from the Book Department of NATIONAL PETROLEUM NEWS, 1213 West Third St., Cleveland 13, for $3.50.

WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers Is Invited

Technology in a Free Oil Industry Is Insurance for Conservation

THE petroleum technologists seem to be the forgotten men in the current public discussion on how long our crude supplies will be sufficient to meet the needs for motor fuel and other products before we must turn to substitute sources to supplement petroleum from the ground. Their contribution in new methods of finding and recovering petroleum and in improved refining processes will continue to be a large conservation factor, however, while the oil industry continues to operate as a free enterprise and can install new methods and plants as economic conditions warrant.

There are indications in present new methods of what advances in refining technique can achieve in conservation of crude oil by manufacturing from it larger proportions of the products of highest economic value. We have also in the development of the science of cracking over two decades ago a most notable contribution to petroleum conservation by refining technology. The technically trained personnel in the industry then was only a handful in number compared with the staffs of the oil companies today.

From 1920, when cracking became a part of refining operations, to the present time we have actually run to refinery stills in this country around 22,000,000,000 barrels of crude. Without cracking and by the earlier methods of refining, in order to produce supplies of motor fuel for the automotive vehicles that came into use we should have had to take 45,000,000,000 barrels of crude from the ground. The volume of crude thus conserved by a technological advancement is larger than the present estimates of all known underground reserves in this country yet to be recovered.

It will also be recalled that cracking first became used in the days following the first World War when many believed that the crude supply then in sight would not be sufficient to meet the needs for motor fuel from the millions of cars the public was buying. Before the 1920s were far advanced, however, many new flush oil pools were brought in and crude supplies were more than ample for refiners' needs. The installation of the more efficient cracking plants continued, however, in the face of floods of new oil and the skimming and topping plants of earlier days fast became obsolete.

The wartime accomplishments of the refining industry have provided the great amounts needed of aviation gasoline, an entirely new volume product, and the large volumes of other essential products from a crude production in this country only a few per cent greater than in the last years before the war. The installation of catalytic cracking units has been pushed to provide the base stocks for aviation gasoline and the light ends for aviation gasoline blending materials. These same units in postwar operations will provide for the practical conservation of crude through their flexibility in increasing the yield of products of high economic value, at the expense of the baser products and without increasing the volume of crude oil run to refinery stills.

At the recent meeting of the American Institute of Mining and Metallurgical Engineers in New York recently one authority estimated that motor fuel requirements in 1950 for the nation would be 24% larger than in 1941. If the catalytic units already built or building in the U.S. were used in such a way as to make a maximum yield of high quality automobile gasoline without shutting down other cracking units, the average gasoline yield could be increased to about 57% of the crude run to stills, as compared with around 45% in 1941, Robert E. Wilson, president of the Pan American Petroleum & Transport Co., stated in a recent address. The resulting increase in output of gasoline would meet this estimated gain in gasoline demand by 1950. Uneconomic though such an operation might be it illustrates the high degree of flexibility in modern refining practice. "The new art of catalytic cracking will probably exert as large an influence on the quantity and quality of future gasoline as did the original Burton thermal cracking process," said Dr. Wilson.

"As a matter of fact", he continued "the only remaining limitation to the yield of gasoline obtainable from a barrel of crude, by processes already developed, is the public demand for other products whose economic value is close to that of gasoline, namely, kerosine, lubricants and household fuels. This fact in itself should put a higher postwar value on every barrel of crude in the U.S. because it will no longer be necessary to produce a large by-product of heavy fuel which would have to compete with coal."

Similar views on the future of catalytic cracking are held by Walter Miller, vice president of Continental Oil Co., Ponca City, Okla., chairman of the refining committee of the Petroleum Section of the A.I.M.E., who said at its recent meeting: "Catalytic cracking is rapidly displacing the comparatively inefficient thermal cracking operations and this trend will be extended much further after the war as construction materials become available and as designs for smaller-scale catalytic cracking units are developed for the intermediate and smaller size refining units.

"Catalytic cracking establishes a trend to the conservation of crude oil in that more and better motor fuel and furnace oil is made possible with a material reduction in the production of heavy low-value industrial fuel oil."

While the possibilities for conservation of crude through catalytic cracking are now established, it is likewise known that other new processing methods for petroleum and natural gas will serve to extend our crude supplies in the future. Catalytic processes will bridge the gap to the next conservation step of catalytic oil hydrogenation, technically and practically worked out, but not now commercially feasible, stated Mr. Miller. Polymerization processes now make high quality gasoline from refinery gases which in the past were wasted or burned as fuel. Alkylation, not even considered possible a few years ago, is now a practicable method for converting other gaseous compounds into gasoline.

There are now 8000 to 10,000 technical men engaged in research in the petroleum industry, who are finding new methods for recovering and refining petroleum which can be applied by the oil companies for more efficient utilization of petroleum products. Their experience and abilities, as long as they can be rewarded by a free oil enterprise as in the past, is the best insurance for conservation of our petroleum supplies.

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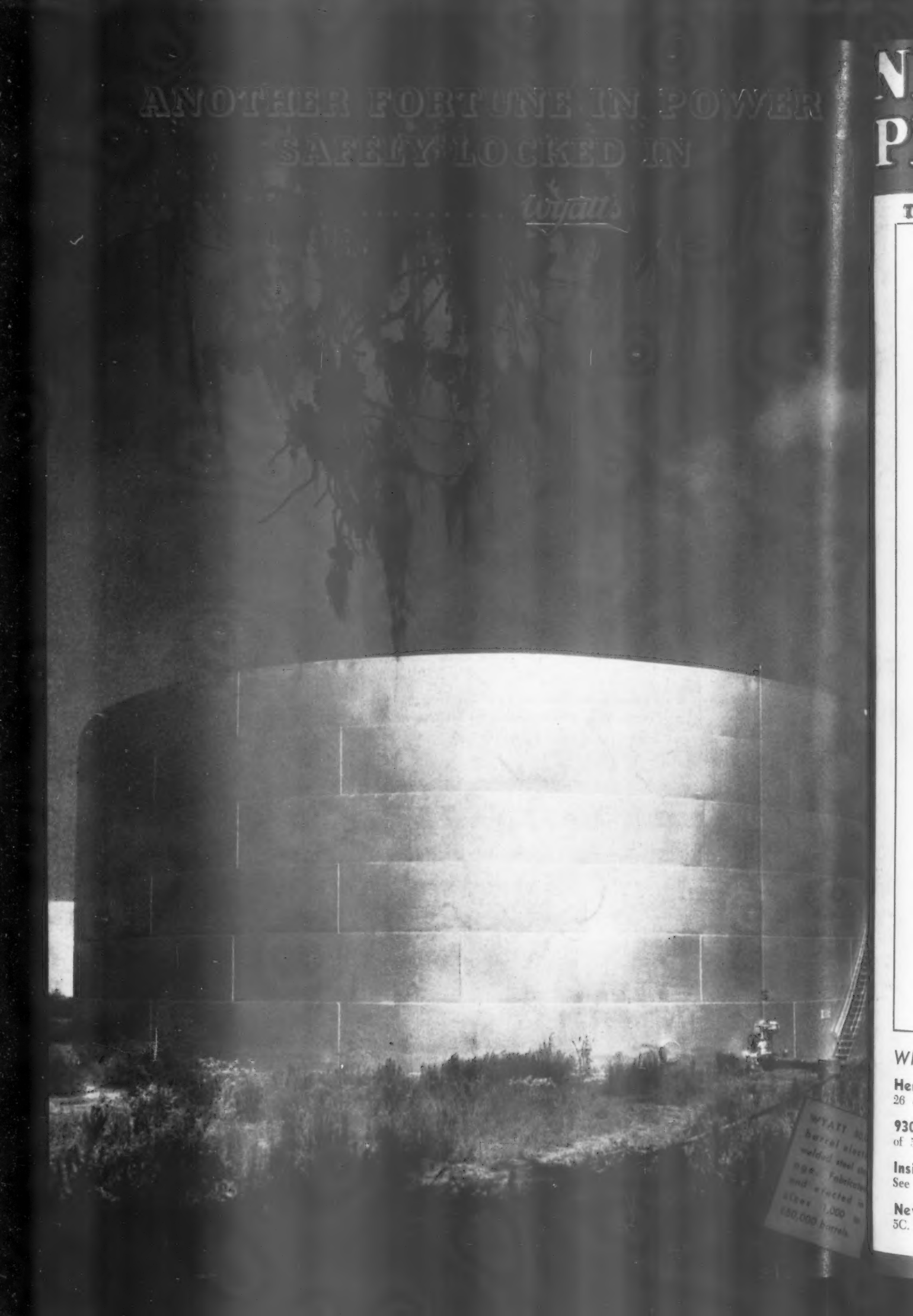
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